RAISING MEAT RABBITS IN ALBERTA

This publication was prepared for
Alberta Agriculture
by:

BRIARPATCH FARMS LTD.,
ARDROSSAN, ALBERTA.

Copies of this publication may be obtained from:

Print Media Branch
Alberta Agriculture
7000 - 113 Street
Edmonton, Alberta, T6H 5T6
OR
Alberta Agriculture's district offices

Issued 1983 03 3M

CONTENTS

I. Introduction 1
Why raise rabbits 1
Size of operation 1
Marketing 1

II. Choosing a Breed 3
New Zealand White 3
Californian 3
Champagne d'Argent 3
Flemish Giant 3
Florida White 4

III. Selecting Foundation Stock 5
Visual assessment 5
Record assessment 5
Age of stock 5
Buying entire rabbitries 6
Buying the buck 6
Tattoos and pedigrees 6
Registered stock 6

IV. The Building 8
Location 8
Size 8
Space allotment within the building 8
Construction and design 9
Heating 10
Ventilation 10
Lighting 11
Costs 11
Professional advice 11

V. Equipment 12
Cages 12
Watering equipment 13
Feeding equipment 14
Nest boxes 15
Other equipment 16
Basic equipment costs 16

VI. Rabbit Nutrition 17
Digestive system of the rabbit 17
Nutritional requirements 18
Feedstuffs 19
Kinds of feed and methods of feeding 20
Medication of feeds 21
Feed storage 21
Nutrition and disease 21
Changing rations 22

VII. Reproduction 23
Fertility 23
Gestation period 23
Age to breed 23
Making matings 23
Determining pregnancy 24

VIII. Breeding Problems 26
Pseudopregnancy 26
Factors that limit conception 26
Neonatal deaths and abortions 27

IX. Raising the Litter 28
Kindling 28
Care of the young litter 28
Fostering 28
Causes of losses in newborn rabbits 28
Care of the young litter 29
Lactation 29
Causes of losses in young out of the nest box 31
Weaning 31

X. Diseases and Abnormalities 32
Stress 32
Diseases 32
Abnormalities 34

XI. General Herd Management 37
Handling rabbits 37
Tattooing 37
Determining sex 38
Castration 38
Sanitation and disease control 38
Consulting a veterinarian 39
The use of drugs 39
Submissions of specimens for laboratory diagnosis 39
Daily management schedule 40
Breeding programs 40
Further considerations 41

XII. Selecting Replacement Stock 43
Methods of improvement 43
Progeny testing 43
Replacement numbers 43
Selecting does 44
Selecting herd bucks 44

XIII. Genetics and Breeding Systems 45
Genetics 45
Traits 45
Breeding systems 46

XIV. Record keeping 47
The doe card 47
The buck card 47
The daily work card 47
Feed conversion ratio 49
Herd production summaries 49
Financial records 49
Pedigree book 49
Using home computers 50

XV. Economics 51
Capital costs 51
Operational costs 51
Income 52

XVI. Problems of Expansion 54

XVII. Glossary of Rabbit Terms 56

References 58

RAISING MEAT RABBITS IN ALBERTA

I. INTRODUCTION

This publication is an attempt to set out the general principles of rabbit raising and to present the methods possible in carrying out those principles with particular emphasis on the rabbit industry as it exists in Alberta. Where possible, the advantages and the disadvantages of various methods will be discussed. It will be up to the interested rabbit raiser to decide which methods might best serve his/her particular circumstances.

WHY RAISE RABBITS

Rabbits have a great biological potential to produce meat. In the years to come, with rapidly increasing world population and resulting pressure on food production, the domestic rabbit may well become one of the world's most important livestock species. In the future, animals that can be fed on forages will have an advantage over those which must be fed on grain. Rabbits can be fed high forage, low grain diets that do not compete with human food requirements. Of all livestock, rabbits utilize forage most efficiently. Furthermore, rabbits can be in a constant state of reproduction, exhibit a quick rate of growth and have a high degree of genetic diversity.

Rabbit meat is a highly nutritious product. It is low in fat which is of the unsaturated type, and is very low in cholesterol, making it a good meat for coronary patients. Rabbit meat is lower in sodium content than red meat but contains about the same amounts of iron and vitamins.

Table of Comparative Nutritional Values of Common Meats*

Edible Portion, uncooked	% Protein	% Fat	% Moist.	Cal./ Pound
Rabbit	20.8	10.2	67.9	795
Chicken (frying)	20.0	11.0	67.9	810
Veal (medium fat)	19.1	12.0	68.0	840
Turkey (medium fat)	20.1	22.2	58.3	1,190
Lamb (fat)	15.7	27.7	55.8	1,420
Beef (fat - good grade)	16.3	28.0	55.0	1,440
Pork (medium fat)	11.9	45.0	42.0	2,050

AN IMPORTANT CONSIDERATION

Anyone who thinks of raising rabbits as a way to quick riches with little effort should not get involved. However, in return for personal interest, effort and a reasonable capital outlay, a rabbit raiser can produce wholesome meat for home use, realize a small profit and collect the best organic manure available. Nevertheless, in addition to an instinct for keeping livestock, some knowledge and experience of raising rabbits is essential for success, whatever the size of the rabbitry. The training ground for any rabbit raiser is the school of practice. The best possible advice to be given to a novice is to begin on a small scale and expand only when the necessary experience has been gained. Errors will then be less costly.

It is important that the novice begin with a starter unit containing no more than 20 does and 3 or 4 bucks. A rabbitry of this size will provide the beginning rabbit raiser with a wide variety of experience in rabbit husbandry. If, after a full year's practice, one decides to continue raising rabbits, one should have developed a good starter herd. If, on the other hand, one concludes that raising rabbits is not feasible, one can easily dispose of the herd. A small operation, whether a success or a failure, will not be a costly one.

SIZE OF OPERATION

The primary considerations are the amount of time that can be allotted to the rabbitry and the amount of capital that can be invested in it. A small backyard rabbitry containing a buck and three or four does will furnish sufficient meat to vary the diet of the average family. A rabbitry with 20 to 200 does may be considered as part-time employment. A 200-doe rabbitry would require a minimum of four hours per day of the operator's time. Working full-time, a husband and wife team could handle approximately 600 does. Such an operation would definitey exceed the 40-hour work week. However, a rabbitry of more than 300 producing does has never been operated successfully in Alberta. Any such ventures to date have proven too labor and capital intensive and have been attempted with inadequate provision for housing, ventilation, sanitation and the like. It may be possible for one couple to care for a 500-doe rabbitry and be successful, if the rabbitry is well-constructed and well-managed.

Whatever the size of the contemplated operation, a market outlet is essential and must be established before the rabbit raiser proceeds.

MARKETING

Section 5, Chapter M10 of the **Meat Inspection Act** of the province of Alberta states that:

"...no person shall sell, offer for sale, transport or deliver to any person meat unless

* Robert Bennet, *Raising Rabbits the Modern Way*, Garden Way Publishing, Vermont (1975), p. 35.

(a) the animal from which the meat was obtained was inspected by an inspector under section 4,

(b) the slaughter of the animal took place at an abattoir or an establishment,

(c) there was a post-mortem inspection of the carcass of the animal from which the meat was obtained conducted by an inspector immediately after the slaughter of the animal, and

(d) the meat is judged by an inspector to be healthy and fit for human consumption and the meat is stamped with an inspection legend or is labelled, as provided in the regulations."

If there is not a processor in the immediate area, it follows that one will be limited to "farm gate" sales of live rabbits. If a rabbit processor is operating in the area, it would be wise for the prospective rabbit raiser to talk to him, as well as to other raisers who deal with the processor, to find out the extent of the business, the demand for fryer rabbits, the stability of the market, the stability of buying prices and whether or not pick-up is included. The nearer the rabbitry is located to the processor, the better. Transporting live rabbits over long distances is not profitable owing to high fuel costs, the cost in work hours and the weight loss incurred by transported animals.

In Alberta today the fryer market has the greatest potential for future expansion. Ideally, fryers should be sold at 8 to 10 weeks of age and weighing approximately 1.8 kg to 2.3 kg (4-5 lb). Culls from breeding herds may be fattened for roasters, but the market for them is limited, and they bring reduced prices.

Raising fur breeds solely for their hides is financially not feasible because of the expense involved in raising the animal to adulthood with a prime coat.

There are limited contracts currently available for the sale of rabbits to laboratories in Alberta. Laboratories are profitable outlets but require deliveries with exacting specifications and rabbits of known disease-free strains produced under optimum conditions.

The pet store market is also limited and seasonal.

Many veteran raisers supplement their rabbitry's income by selling breeding stock, because quality breeding animals are always in demand. Nevertheless, raisers of breeding stock must still have a regular market for their culls and extra rabbits.

In Alberta, and indeed all of western Canada, the future would seem to hold a place for the production of rabbits. Old World countries have valued the rabbit as a protein source for centuries. In North America, however, the rabbit has long been overshadowed by other meat sources.

Rabbit Consumption Figures

Country or Province	Per Capita Consumption per Year	
Alberta (1980)	28.35 g	(1 oz)
Ontario (1971)	56.7 g	(2 oz)
Germany (1971)	150.0 g	(5.25 oz)
Holland (1981)	150.0 g	(5.25 oz)
Great Britain (1971)	250.0 g	(8.5 oz)
Italy (1971)	1500.0 g	(2.6 lb)
France (1980)	5.0 kg	(13 lb)

Producers of rabbit meat in Alberta must undertake to advertise their product and increase rabbit sales. In general the public is unaware of both the value and the fine flavor of domestic rabbit.

II. CHOOSING A BREED

Although there are over 30 breeds of domestic rabbit in North America and all are edible, only the heavier breeds are used for meat production. As some of the heaviest breeds are slow maturing and dark-fleshed, the New Zealand White and Californian breeds are most widely used in commercial rabbitries. These breeds grow rapidly and have a square blocky build; they have a good meat-to-bone ratio and provide firm white meat.

Processors prefer white rabbits primarily because dark hairs left clinging inadvertently to a carcass are unsightly and undesirable. In some areas, processors pay less for colored rabbits.

New Zealand White

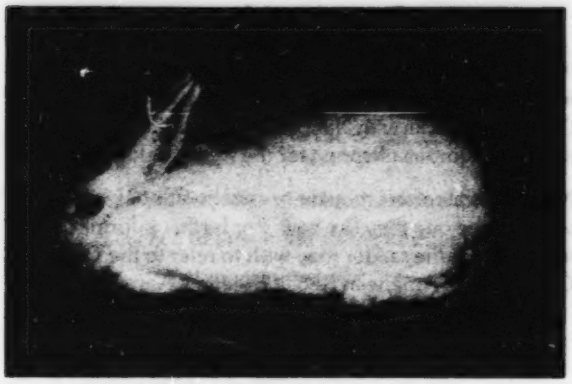


Figure 1. New Zealand White

This breed was developed in the United States for commercial use and is still the most popular breed for that purpose.

Color: White

Eye Color: Bright pink

Description: Body of medium length, well-rounded at the hips with well-filled loins and shoulders in proportion. Ears of medium length with veins clearly visible.

Mature Weights: Bucks 4.5 kg (10 lb)
Does 5.0 kg (11 lb)

Litter size: 8-10

Californian

This breed was also specifically developed for commercial use in the United States.

Color: White body with dark colored (brown to black) ears, nose, feet and tail.

Eye Color: Pink

Description: Plump and full over and around the hips with a firm meaty saddle. Tend to be broad shouldered. Small boned.

Figure 2. Californian

Mature Weights: Bucks 4.0 kg (9 lb)
Does 4.3 kg (9.5 lb)

Litter size: 6-8

Champagne d'Argent

Figure 3. Champagne d'Argent

This breed is one of the oldest known breeds of rabbits.

Color: Black at birth gradually changing to silver with a dark slate-blue undercoat. The whole coat is evenly interspersed with longer black hairs. Medium-fine boned.

Eye Color: Brown

Description: Of moderate length with well developed hindquarters, shoulders and back.

Mature Weights: Bucks 4.5 kg (10 lb)
Does 4.8 kg (10.5 lb)

Flemish Giant

The Flemish Giant is another very old breed favored in Europe.

Color: White, fawn, grey, sandy, blue or black.

Eye Color: Dark Brown

Figure 4. Flemish Giant

Description: Very large with broad chest. Well balanced and proportioned throughout length. Heavy hindquarters. Long ears. Does have larger dewlap. Large boned.

Mature Weights: Bucks 6.5 kg (14 lb and up)
Does 7.0 kg (15 lb and up)

Note: A recent study at Oregon State University* shows that the overall reproductive performance of the Flemish Giant is inferior to that of New Zealand White does because of:

1. Lower conception rate
2. Longer interval between litters
3. Lower litter survival rate
4. Poor feed efficiency from kindling to 21 days

Florida White

The Florida White is a more recent breed developed because of the demand for small fryers and smaller white laboratory specimens. Currently the Florida White is increasing in popularity in the United States, particularly as a choice for home meat production and for crossbreeding with other breeds to improve performance.

Color: White fur of good density and texture

Eye Color: Pink

Description: Meaty and compact with well-rounded tapering to meaty shoulders. A small head on a short neck.

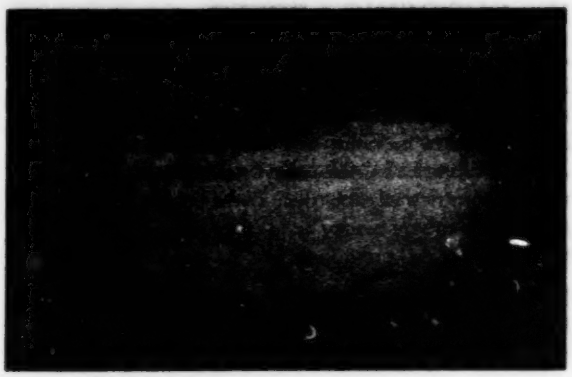


Figure 5. Florida White

Mature Weights: Bucks 2.3 kg (5 lb)
Does 2.3 kg (5 lb)

A rabbit breeder need not be restricted to one breed. Many commercial producers, for example, breed Californian bucks with New Zealand White does to produce vigorous offspring for the fryer market.

Novice rabbit raisers may try several breeds before they settle on the one they like best. For further information on rabbit breeds the reader may wish to refer to the **Official Guide** of the American Rabbit Breeders Association**

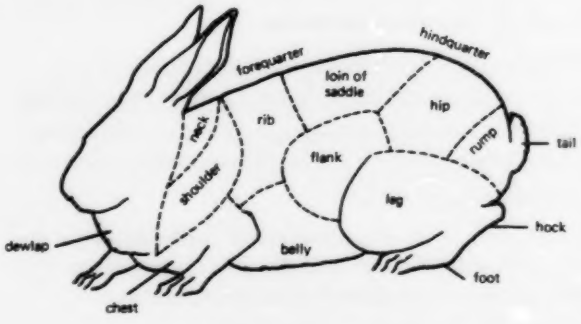


Figure 6. Diagram of rabbit showing sections and parts

* Lukefahr, S.D. *et al*, "Evaluation of the Flemish Giant as a Purebred and a Terminal-sire Commercial Rabbit Breed", *Journal of Applied Rabbit Research* (OSU 1980), Vol. 3, No. 3, P. 14.

** See p. 58.

III. SELECTING FOUNDATION STOCK

Having decided upon a breed, the prospective rabbit raiser's next step is to find local breeders. Buying stock from a distant source does not necessarily guarantee better quality. A local processor can help the novice contact reputable breeders. Alberta Agriculture has the mailing addresses of rabbit clubs and associations, who in turn can provide sources of good breeding stock. A beginning rabbit raiser should visit several breeders before making the final decision to purchase. Selection of prime stock is the most important step toward the success or failure of a rabbit operation. Two guidelines for the beginner are the visual appearance of the rabbits and the records of the rabbitry supplying them.

VISUAL ASSESSMENT

A. The Entire Rabbitry

When visiting any rabbitry the prospective buyer should conduct a visual assessment of the entire rabbitry checking for:

1. The cleanliness of the rabbitry and the rabbits.
2. The presence of unwanted strong ammonia fumes.
3. The absence of sneezing rabbits.
4. Contented calm stock.
5. The abundance of plump young rabbits —
   a. the number of young in each litter, and
   b. the number of does with litters. Two-thirds of the cages of working does should have litters in them.

B. The Individual Rabbit

Each rabbit being considered for purchase should be examined closely with the following in mind:

1. The rabbit is a good example of the breed.
2. The rabbit is healthy and alert.
3. The coat is in good condition. Beware of woolly, sparse or lustreless fur.
4. The eyes are clear and bright rather than dull, cloudy or weepy.
5. The teeth are not yellow or deformed.
6. The ears are clean and free from scabs produced by ear mites.
7. The nose is clean and dry.
8. The paws are not stained or matted from rubbing a wet nose — evidence that the rabbit suffers from snuffles.
9. The dewlap has no sores or bare patches from being rubbed or scratched and is not wet or matted.
10. The hocks are well padded with no scabs or open sores.
11. The sex organs are clean and show no sign of diseases.
12. The rectal area is clean. A dirty rump may indicate the presence of enteritis.
13. The rabbit shows no signs of undue nervousness.

RECORD ASSESSMENT

Although the appearance of the animals is an important factor in the process of selection, full emphasis must be placed on records. The breeder who keeps no records (or will not show records) is to be avoided. From a perusal of the records one is able to learn the following:

1. Regularity of breeding — doe produces 4 to 6 litters per year.
2. Litter size — 7 or more.
3. Rapidity of growth of young — 1.8 kg (4 lb) fryers at 8 weeks.
4. Longevity — does should produce 15 litters.
5. Ancestry and the quality and performance of parents.
6. Feed conversion.
7. Mothering ability of does: check records for loss of young.
8. Fertility — conception rate.
9. Minimal losses — be suspicious of a breeder claiming no losses or one whom you suspect of hiding losses. Remember, however, that even with excellent husbandry, some losses are inevitable.

It takes several years to develop a herd of good quality commercial rabbits. If possible, one should try to buy one's first rabbits from a commercial producer who is raising rabbits successfully. Buying top quality stock, however, is no guarantee of a successful rabbit-raising career. Moving rabbits from one rabbitry to another means subjecting them to a change in climatic conditions, management practices and feeding schedules and this will affect their condition and output.

AGE OF STOCK

Selecting young animals gives one the opportunity to become acquainted with the rabbits and their habits before they reach production age. It also gives the rabbits a chance to get used to the handler. However, choosing mature stock enables the breeder to get the rabbits into production quickly. The two alternatives have various advantages and disadvantages:

A. *Mature Rabbits*

Advantages:
They can be bred immediately.

They adjust more easily to new surroundings.

They already show their meat traits.

They are more resistant to disease.

Disadvantages:
They cost more than young stock.

They are not usually available in quantity.

They may have poor temperaments.

They could be in need of conditioning.

They may have bad habits.

B. *Young Rabbits*

Advantages:
They are less expensive.

They are more readily available.

They more easily adapt to a new handler.

Their weight can be controlled to adulthood.

They are easier to handle at this stage.

Disadvantages:
They are susceptible to adjustment problems.

They do not yet exhibit their adult traits.

Breeding must be delayed until they are sufficiently mature.

It may be advantageous to buy does of varying ages such as 3 months, 4 months and 5 months of age. They can then be eased into production a few at a time.

BUYING ENTIRE RABBITRIES

Entire rabbitries are frequently advertised for sale. Many would-be rabbit raisers find such package deals particularly attractive. In such cases, the reason for the sale should be determined. Most often the reason is that the rabbit operation was unsuccessful and the raiser is getting out of the business. The problems that led to that failure may be purchased with the stock. Any such opportunities should be carefully assessed.

BUYING THE STOCK

Particularly in small herds, the value of the buck is half that of the total herd. Investing in a good buck will improve the herd in succeeding generations; thus, purchasing the buck requires careful attention. The buck should be old enough to breed the eldest does in the herd. Proven bucks are also a great benefit in getting first-time does bred. As a precautionary measure, a junior buck should also be purchased.

In an established herd, one buck can service 12 to 15 does, but in a smaller operation the ratio of bucks to does should be greater, perhaps one buck to five or six does.

A WORD OF CAUTION

Whatever the quality, age and number of rabbits purchased, one should not bring the rabbits home until adequate facilities can be provided to house them. The best breeding stock will not breed to potential in inferior housing, however temporary.

TATTOOS AND PEDIGREES

There are several terms used which apply to the ancestry of purebred stock. Knowledge of these terms will help the prospective buyer.

A *tattoo* or an identifying mark in a rabbit's ear is no guarantee of that rabbit's quality. Breeders should, for purposes of identification, tattoo their rabbits in the *left* ear. The right ear is saved for a possible identification registration number to be placed there by an official registrar of the American Rabbit Breeders Association (ARBA).

A *purebred rabbit* is one which is bred to conform to a certain recognized written standard of perfection. If the purebred rabbit is accompanied by a written record of its ancestry — i.e. a pedigree — it is said to be a *pedigreed rabbit*. The pedigree should contain information on at least three generations of ancestors on both sides of the family. For the rabbit and each ancestor it should include:

name and ear number
registration number if registered
color and markings
sex
weight
date of birth
show winnings and grand champion numbers

Without the pedigree paper a rabbit is not considered purebred. It is wise to remember that a pedigree is only as good as the honesty and integrity of the rabbit raiser who produced it. In Alberta, pedigree papers are not currently in general use.

REGISTERED STOCK

In order to apply for the registration of any rabbit, the owner of that rabbit must be a member of ARBA. The candidate rabbit must be a purebred, show a three-generation pedigree and be a mature specimen. Furthermore, it must be examined by a licensed ARBA registrar to determine that it is free of all defects and that it

meets the minimum requirements of the breed standard. Simply being the offspring of registered parents is not good enough; each specimen must be individually examined. The registrar tattoos the registration number in the right ear of the rabbit. The registration application is then completed carrying the corresponding number. This application form requires a copy of the three-generation pedigree as well as information on fur quality, bone, weight, color, head, eyes, date of birth, owner's name, etc. plus the registrar's personal comments. The registrar retains one copy, gives the owner one, and submits one to ARBA. If all the details are in order, a certificate of registration with the appropriate seal is issued by ARBA.

There are four categories of registration: a plain seal means the rabbit has no registered ancestors; a red seal means the parents and grandparents are registered; and a red/white/blue seal means all ancestors are registered. Any break in registration means the line must start all over again. If, for example, a doe from registered parents has a litter and then dies before she can be registered, any new rabbits from that litter must be registered with the plain seal.

It should be obvious from the above that registered stock is of greatest importance to raisers of fancy breeds whose interests lie in showing their rabbits. Registered stock, particularly in Alberta, is rare. In fact, rabbits chosen for registration or winners of rabbit shows (i.e. rabbits chosen primarily for conforming to the standards of the breed) may not be the best commercial producers. Commercial rabbit raisers are concerned primarily with meat production, rather than with conforming to breed standards.

IV: THE BUILDING

LOCATION

Most persons raising rabbits in Alberta begin by converting existing buildings — such as hog barns or tool sheds — into rabbitries. Generally the buildings are adequate for rabbits, but such buildings are not without problems. In converted buildings extra provision must be made for effective ventilation to keep the rabbitry dry and draft-free.

It is assumed that the rabbit raiser wishes to raise rabbits under the best possible conditions by constructing a rabbit barn designed specifically for rabbits. Presumably the chosen site will be within reasonable shipping distance of the market. The first step will be to investigate the zoning by-laws and the building restrictions covering land use to ensure that the rabbit building is consistent with the building code.

Before constructing a building, study the land so that a site may be chosen to provide maximum protection from winter winds and summer sun. Rabbitries in northern climates usually run east and west to maximize exposure to the winter sun. Existing trees or shelterbelts can deflect the gusts of prevailing winds, while shade trees can be planted to protect the rabbitry from the intense sun of summer.

The soil on the chosen site should be examined to guarantee proper drainage for the rabbitry. A steady supply of good drinking water for the rabbits should be available.

SIZE

The size of the building will be determined by several factors:

1. The amount of money available.
2. The number of rabbits intended for the unit.
3. The system of caging to be used.
4. The breeding program to be followed.

A rectangular structure is the simplest and most efficient design and may be extended at a later date to accommodate an expanded herd.

SPACE ALLOTMENT WITHIN THE BUILDING

Building plans and space arrangements are critical because labor must flow easily from one cage to another. A clear-span building is easier to plan, but is somewhat more expensive than a post-and-beam building. In the latter, the posts must be spaced to match proper cage placement.

The aisles between cages should be uniform and not less than 90 cm (35.5 in.) wide to accommodate free movement of handlers and equipment. The actual walkways should be narrower than the width of the aisles to allow an extension of the manure pits in front of the cages, thus keeping the walking surface clear of manure and urine. Storage and supply areas should be at one end of the building. Long rows are more readily adapted to mechanization than short rows.

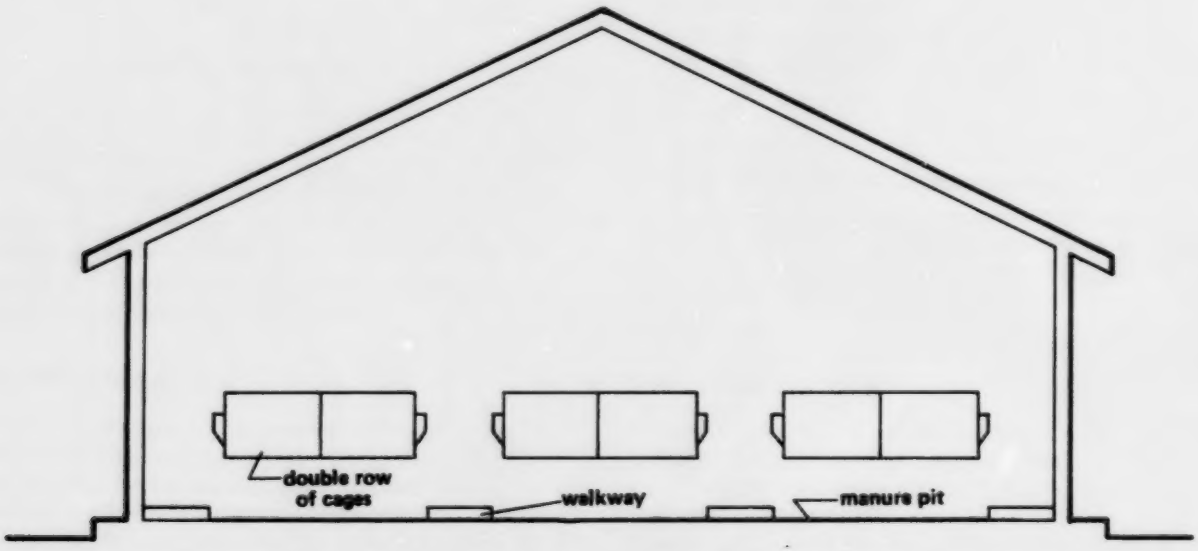


Figure 7. End view of barn showing basic spacing of cages

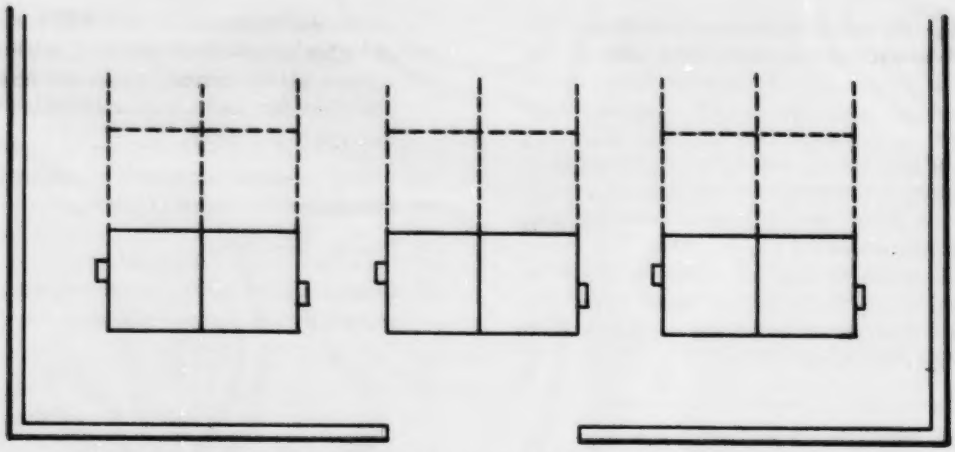


Figure 8. Top view of barn showing basic cage allotment

The cage space required for most commercial rabbits is 0.7 m² (7.5 ft²) Standard cage size giving this area is 75 cm in depth × 90 cm front width (30 in. × 36 in.). Banks of cages should not be lined up along the walls, because they restrict air flow and impede manure removal. Arranging cages in double rows down the centre of the building is preferable. There should be about 3 m (10 ft) of space at both ends of the rows of cages to facilitate the turning of any equipment used in feeding rabbits or in disposing of the manure

The particulars including the area of the building shown above (see top view) are as follows:

Cage Floor (width × depth): 90 cm × 75 cm (3 ft × 2.5 ft)

Number of Cages: 6 across building

Total Cage Area: 0.7 m² × 6 = 4.2 m² (7.5 ft² × 6 = 45 ft²)

Aisle Width: 90 cm (3 ft)

Building Width: 8.54 m (28 ft)

Floor Area of Building: 7.8 cm² (3 ft × 28 ft = 84 ft²) (for 6 cages plus aisles)

Total Floor Area per Standard Cage: (84 ÷ 6 = 14 ft²) (including aisle) *

After laying out the floor plan carefully and determining the width of the aisles and the location of the cages, the rabbit raiser can determine the total building space required. With a building 33.55 m (110 ft) long, for instance, the rabbit building above would have a capacity for 180 single-tiered cages.

* If 3 m (10 ft) extra space is allowed at each end of the rows, 1.58 m² (17 ft²) of building area per standard cage will be required.

CONSTRUCTION AND DESIGN

The rabbitry should be designed to be a complete environmental unit built with year-round rabbit production in mind. It should also facilitate good management by being easy to work in and easy to clean and disinfect. The main area will hold the doe pens and the growing pens. Cages holding replacement stock and breeding bucks may be grouped together in this area as well. Ideally, the bucks will be in a separate room of their own.

The rabbitry should also contain two separate isolation units: one for sick rabbits and one for newly acquired stock. (The isolation units may be in different buildings altogether.) There should be a feed storage area that can be kept clean, dry and free from insects and rodents; a work area where rabbits can be palpated, tattooed, etc.; a utility area for cleaning cages, storing nest boxes, etc.; and an office area where records are kept.

Concrete floors in all areas of the barn are not recommended. Ammonia production from urine concentration is usually increased owing to inadequate drying where concrete floors are used. It is much better to use earth, sand or gravel manure pits (with some slope or tile-enhanced drainage) under the cage areas and to pour concrete walkways between them. Concrete footings should be poured around the perimeter of the building.

Wooden walls will suffice. Before ordering the roof trusses, one must determine the possible weight that might be hanging from them: cages, feed and feeders, water and watering equipment, nest boxes and rabbits. The walls of the building should be well insulated with a minimum of R12 and the ceiling with R20 to help avoid temperature extremes. The interior wall covering should

be ammonia-proof and moisture-proof to facilitate cleaning and disinfecting the interior of the rabbitry.

HEATING

For year-round production, rabbits must be protected from direct sunlight, radiating heat and high temperatures. A mature buck may be rendered sterile if exposed to temperatures of 29°C (85°F) for five consecutive days. On the other hand, if the rabbitry is too cold, mortality among the kindled young will be high from exposure. The doe will be reluctant to pull her fur to line the nest box if she herself is cold.

The ideal temperature is debatable. Some raisers maintain that a minimum temperature of 2°C is adequate: just warm enough in the rabbitry to keep the drinking water from freezing. Others suggest an optimal temperature to be 18°C, while still others specify 15.6°C. It would seem that temperatures in the area of 10°C seem to be most comfortable for rabbits. The most important point to remember is that extremes of temperature — especially in any single day — are to be avoided. A constant temperature helps promote regular breeding.

The two most commonly used heating systems are hot air heating and hot water heating. The hot air system is cheaper and easier to install, but is more costly to operate and also causes fluctuating draft problems. The hot water system is more efficient to operate and maintains a much more uniform temperature in the building, thus reducing the stress on very young rabbits.

VENTILATION

The ventilation system of the rabbitry has many important functions:

1. It must bring in fresh air. The air should be changed at least four times per hour in the winter, while in hot weather as many as 16 complete changes of air per hour will be necessary.
2. It must remove excess moisture and control humidity. It is believed that relative humidity levels below 45% will dry nasal passages while relative humidity levels over 70% will impose respiratory distress upon the rabbits and will lead to an increased incidence of respiratory problems in the herd.
3. It must remove warm air and help to control temperature levels.
4. It must dilute and remove toxic fumes. Raising many animals in a confined space, particularly in winter, and allowing manure to build up will lead to conditions favoring the continued release of ammonia. An ammonia level of 20 parts per million or higher is considered harmful to rabbits. If ammonia levels irritate the eyes and nose of the rabbit handler, such fumes will certainly be very irritating to the rabbits.
5. It must dilute the numbers of bacteria and viruses by removing them from the building.
6. It must remove dust.
7. It must do all of the above without causing drafts or making the rabbits uncomfortable.

Because of the extreme weather conditions in Alberta, controlled environment housing is required for rabbits. The ventilation rate in winter must be precise. It must move enough air to keep the inside conditions comfortable, but not at the expense of losing too much of the heat of the building. On the other hand, as little of the existing air as possible should be recirculated, for it may no longer be clean.

There are three basic ventilation systems which can be used. Each type has both advantages and disadvantages.

Negative Pressure Ventilation System — This system is commonly used in all types of livestock buildings. Fans are mounted to pull air *out* of the building while the air inlets control the amount of air let *in*. The result is a partial vacuum (low pressure area) inside the building. This system creates a uniform movement of air. One minor problem with it is that the loose fur from the rabbits will tend to build up on the fan blades, causing the fans to decrease in efficiency. The fans must therefore be cleaned frequently.

Positive Pressure System — In this system the fans are mounted to draw fresh air into the building, thus creating a higher pressure inside the building than outside. This system works well in older buildings because the air is forced out through cracks, thus reducing the possibility of cold drafts unless a well-designed duct distribution system is included with the fans. However, drafts are caused by the fans blowing air into the barn. In a rabbit barn, this system is not affected by the problem of loose hair.

Natural Ventilation System — This system is normally used in a building with a high open ceiling. Air inlets are located on the side walls close to the ground and a vent is located at the centre peak of the building. The ventilation is caused by cool air entering the building near the ground level. As the air warms, it rises and exhausts from the barn at the peak. This system does not require fans, but creates problems in hot weather by not moving enough air to keep the barn cool. Furthermore, in winter the warmest area in the barn will be near the

roof, while the coldest area will be at ground level beneath the cages. The cold drafts so produced may be lethal to very young rabbits and may also be responsible for outbreaks of snuffles.

In Alberta the winter heating of the rabbitry is less of a problem than is the ventilating of it. Rabbits compensate for the cold by consuming more food, carrying more fat and producing thicker fur. They can do little to compensate for the air they must breathe. During intense summer heat they will consume less food and drink more water, but they cannot shed their fur coats. Constant and efficient ventilation can keep down losses as a result of heat prostration and can reduce heat-produced sterility. Moving air has a cooling effect which can be increased by adding evaporation units or mist cooling techniques to the ventilation system.

It is a wise investment in even the smallest rabbitry to install a mechanical fan ventilation system controlled by timers and thermostats. A totally controlled housing environment is the ideal situation, but the cost of such an automated system is prohibitive for rabbits under Alberta climatic conditions.

LIGHTING

There are varied opinions about the effects of lighting upon rabbit production. Some rabbitries remain unlighted except when raisers are working in them. Some raisers believe that bucks have a higher semen concentration and mature more quickly on short days (8 hours of light). Does, on the other hand, seem to require longer days (14-16 hours of constant light) to maintain production.

Does exposed only to natural light have a fall barren period as the days begin to shorten. The incidence of this barren period decreases if the does are kept on a constant lighting program. This can be done by adding lights and a time clock to provide the longest day length which occurs naturally in June. The amount of illumination required in the rabbitry depends on the latitude at which that rabbitry is located.

Experiments are still being conducted on the *quality* of light to best enhance rabbit production (incandescent versus fluorescent; daylight blue versus purplish-pink, etc.) and the desired intensity of the lighting. To date there are no definite conclusions on the subject.

COSTS

The minimum cost (1981) for the construction of a basic rabbitry with the features advocated in this chapter is $\$160/m^2$ ($\$15/ft^2$). Variables altering the basic cost are heating and ventilation. Additional expenses such as land costs and the cost of drilling a well or bringing in a gas line are not included in the basic figure.

PROFESSIONAL ADVICE

Whether constructing a new rabbitry or renovating an existing building, the rabbit raiser should make use of the engineering services provided by Alberta Agriculture. For information on any or all aspects of design, construction, heating and ventilation as well as the costs involved, consult with a regional agricultural engineer or the engineering resource branch, Alberta Agriculture.

V: EQUIPMENT

CAGES

Wire cages for medium-sized breeds of rabbits are usually 75 cm (30 in.) deep by 90 cm (36 in.) wide by 45 cm (18 in.) high. They are hung from the ceiling at a convenient working height for the raiser, with the cage floors at least 75 cm (30 in.) above the walkway to facilitate cleaning underneath. Such cages are usually hung back-to-back in double rows.

For the floors use 14 gauge welded galvanized wire 12.5 mm × 25 mm (0.5 in. × 1 in.). The sides are made of 25 mm × 25 mm (1 in. × 1 in.) or 25 mm × 50 mm (1 in. × 2 in.) 14 or 16 gauge wire. Some breeders use "baby saver" wire on the ends and sides to guard against the loss of young rabbits born outside the nest box. Ten centimetres (4 in.) of this wire are 25 mm × 12.5 mm mesh; the remainder is 25 mm × 25 mm. The tops of the cages may be made of 25 mm × 50 mm wire, 14 or 16 gauge, and constructed flat or Quonset style.

Figure 9. Quonset style cages, single tier

Single-tiered cages may be either top-opening or front-opening. In the top-opening model, the entire top of the cage may be raised from the front edge for easy access to the rabbits. In the front-opening model, a doorway must be cut into the front of the cage and made large enough to facilitate the removal of rabbits and the insertion of a nest box. A wire door and fastener must then be secured over the opening. Some raisers find handling rabbits in front-opening cages to be awkward.

A major decision which will influence cage construction is whether the cages are to be single-decked or multi-tiered. The single tier of cages is easier to construct, easier to erect and easier to clean. Such cages provide the raiser with easy access to the rabbits and do not impede manure disposal. On the other hand, single-tiered cages make for inefficient utilization of space and increase the cost of constuction per working doe.

Figure 10. Front-opening cage

Multiple-tier installations (either two or three tiers) involve more intricate construction, are harder to keep clean, put more demands on the ventilation system and make handling of the rabbits more difficult for the raiser. But because more working does can be housed within the building, the cost per working doe is reduced.

If more than one tier of cages is used, dropping boards must be installed beneath each to catch the manure. The dropping boards should be sloped toward the backs of the cages and should be installed to leave approximately 15 cm (5-6 in.) of space between the tiers.

Personal preference and the number of cages required, (depending upon the breeding program to be followed) as well as the size of the rabbitry building, will influence the decision as to whether or not to tier.

NOTE: Cages for bucks, replacement stock and saleable stock can be smaller than the standard breeding cages, because each cage will house only one animal. Suggested sizes for such cages (depth × width × height) are:

45 cm × 60 cm × 38 cm	(18 in. × 24 in. × 15 in.)
60 cm × 60 cm × 45 cm	(24 in. × 24 in. × 18 in.)
45 cm × 75 cm × 45 cm	(18 in. × 30 in. × 18 in.)

HOW MANY CAGES?

Depending upon the breeding program followed, the rabbit producer will require 40% to 90% more cages than the number of breeding does kept. Extra cages permit experimentation with various breeding programs; a lack of extra cages will limit the producer to a wean-to-market program. Having extra cages will allow a stepped-up breeding program with increased fryer production.

Extra cages also give the rabbit raiser more flexibility. In a one-hundred doe rabbitry the actual number of breeding does may vary from 85 to 90 during the winter, to 110 to 115 in the summer. During the winter the additional cages may be used for raising extra replacement stock for the coming summer and extra breeding stock for sale in the spring, when the demand for stock is at its highest.

To estimate number of cages required for rabbitries of various sizes on different breeding programs use the following calculations:

Breeding Program:	Ween-to-market	28-35 Day Breed-back	14-21 Day Breed-back
	Extra cages required:	*Extra cages required:*	*Extra cages required:*
	10% Buck Cages	10% Buck Cages	10% Buck Cages
	10% Fattening	25% Fattening	45% Fattening
	10% Replacement	15% Replacement	20% Replacement
	10% Saleable Stock	10% Saleable Stock	10% Saleable Stock
24 Does:	24 Doe Cages	24 Doe Cages	24 Doe Cages
	3 Bucks	3 Bucks	3 Bucks
	3 Fattening	6 Fattening	11 Fattening
	3 Replacement	4 Replacement	5 Replacement
	3 Saleable Stock	3 Saleable Stock	3 Saleable Stock
	36 Cages Required	40 Cages Required	46 Cages Required
100 Does:	100 Doe Cages	100 Doe Cages	100 Doe Cages
	10 Bucks	10 Bucks	10 Bucks
	10 Fattening	25 Fattening	45 Fattening
	10 Replacement	15 Replacement	20 Replacement
	10 Saleable Stock	10 Saleable Stock	10 Saleable Stock
	140 Cages Required	160 Cages Required	185 Cages Required
150 Does:	150 Doe Cages	150 Doe Cages	150 Doe Cages
	15 Bucks	15 Bucks	15 Bucks
	15 Fattening	38 Fattening	68 Fattening
	15 Replacement	23 Replacement	30 Replacement
	15 Saleable Stock	15 Saleable Stock	15 Saleable Stock
	210 Cages Required	241 Cages Required	278 Cages Required

The above figures show that a larger rabbitry working on an accelerated breeding program requires almost two cages per breeding doe. Not only are the cages a large part of the expense of the operation but so, too, is the size of the building required to accommodate them.

A partial solution to the problem of the large number of extra cages is the split or European cage. Such a cage is of standard size but is divided into halves by a wire partition in which there is a door allowing the doe and her young to utilize the entire cage area. When the young are weaned at 28 days, the door between the two halves of the cage is closed, separating the doe from her litter. In such an arrangement the raiser has more control over the feeding of the doe. By the time the next litter is ready to leave the nest box, the first litter has been marketed. The door of the partition is once again opened, allowing the newest litter access to the total cage area. Split cages significantly reduce the cage space required per doe. Each cage half, however, requires a feeder and a watering appliance.

Split cages can also house two replacement rabbits so that all cages within the rabbitry can be of one size and design, leading to greater versatility.

Figure 11. Split or European cage

WATERING EQUIPMENT

Fresh clean water must be available to the rabbits at all times. Water crocks or pop bottles inverted in cups or equipped with stoppers and drinking tubes which curve into the cages are inexpensive but time-consuming appliances to fill. They must be refilled often and cleaned regularly. Because manual watering takes a great deal of time, an automatic watering system adds to the efficiency of even the smallest rabbitry.

The simplest watering system is a semi-automatic one which requires the raiser to fill a holding tank (perhaps just a large bucket) with a garden hose or a pail. The holding tank is elevated a few feet above the hutches, and the weight of the water forces it to flow down a system of pipes along the cages. Valves are inserted into the pipe at

Figure 12. Automatic watering system

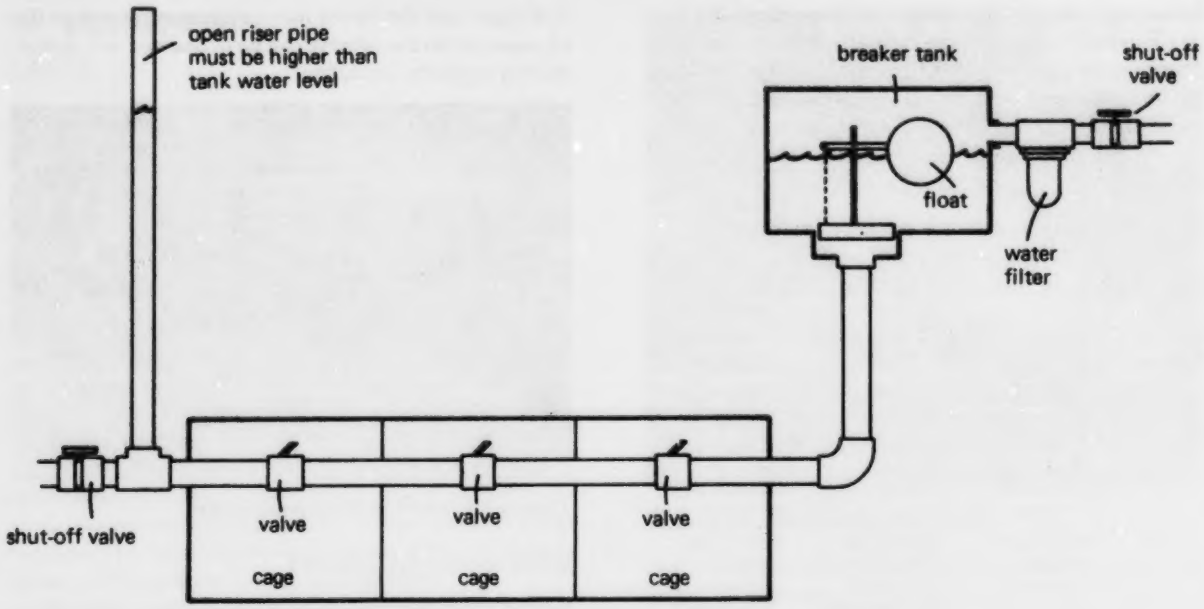


Figure 13. A simple gravity pressure system

each cage. The rabbits merely bite on the valves to release the water.

If it is a "dew-drop" valve, the biting-licking action of the rabbits dislodges a metal stem in the valve allowing the water to trickle into their mouths. When they cease licking, the metal element drops back into the opening to plug it, and is held in place by the pressure of the water.

If it is a "pivoting" valve, the metal stem will be on a spring. It bends out of the way during drinking and swings back to stop the water flow when the rabbit has ceased drinking.

A fully-automated watering system requires float tanks or pressure regulators. Pressure regulators are necessary if the water system is connected to a city water line or a farm pressure system. Pressure should be reduced to about 20.7 kPa (3 lb per sq. in.). Steel pipe, rigid plastic pipe or flexible plastic pipe may be used to convey the water to the cages. Steel pipe is the most durable but also the most expensive pipe to install. Flexible pipe must be supported with brackets to prevent sagging and consequent air locks in the water line.

A complete watering system will require the use of filters to remove mineral deposits and very small granular accumulations which can cause the water valves (nipples) to leak, adding extra unwanted moisture to the manure below the cages. Water pressure that is too low will also lead to water dripping from the valves, whereas water pressure that is too high will restrict the rabbits' water intake.

Having incomplete, improperly installed, or mismanaged watering systems may create problems that are a major cause of mortality for young between 3 weeks and market age. Even a closed watering system must be regularly maintained to discourage the growth of harmful bacteria. Continuous superchlorination with 5 ppm of household chlorine bleach may be used to protect the rabbits.

FEEDING EQUIPMENT

In an efficient rabbitry the feeders must be installed so that they can be filled from outside the cages. They should be large enough to hold one day's supply of feed for the maximum number of rabbits that might be housed in the cage. Feeders should be of metal so that the rabbits cannot chew them and so they can be cleaned and disinfected easily. Various brands of metal feeders are available from supply houses. Some of the feeders have a fine screen on the bottom to permit feed dust (fines) to sift out of the feeders. The feeders should also have an inward-facing lip that prevents the rabbits from scratching the feed out of the feeder.

Feeders should be installed 7.5-10 cm (3-4 in.) above the floor of the cage to prevent the rabbits from contaminating the feed with droppings or urine.

Creep feeders are designed to be used by young rabbits when the producer wishes to feed them a ration different from that of the doe while she is still in the cage with them. The main feature of the creep feeder is that the

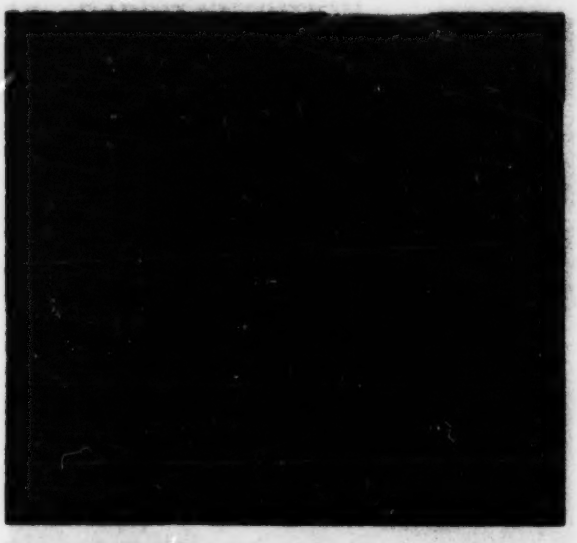


Figure 14. Metal feeder

food is reached through round openings in the side of the feeder. Only the young are small enough to reach through the holes to get to the high-protein food on the inside. Creep feeders are often installed in the cages directly beneath the regular feeder which is somewhat raised, thus preventing the young from sitting in the feed.

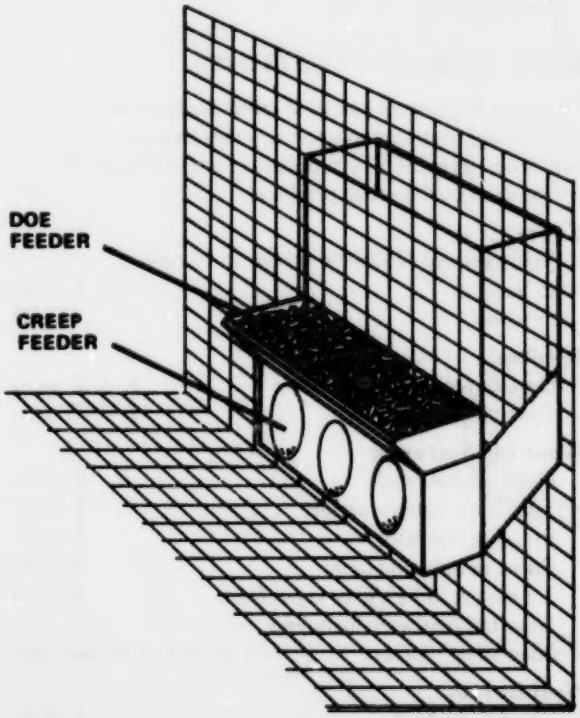


Figure 15. Creep feeder

A rack for hay may be constructed on the outside of the cage simply by affixing a single sheet of wire or metal to the cage with hinges at the bottom and a small length of wire or chain which fastens the top of the rack to the cage to form a "V" with the side of the cage. The rabbits nibble the hay through the cage wire.

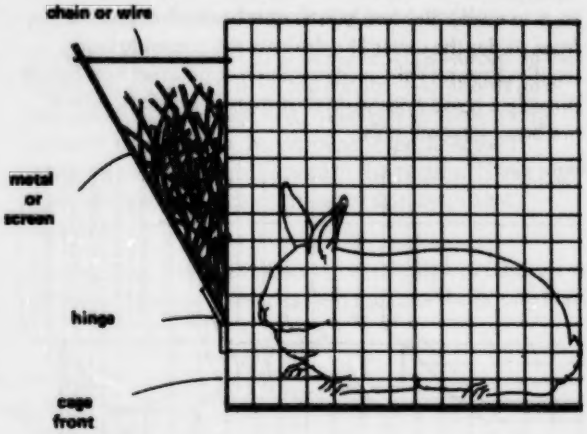


Figure 16. A simple hay rack

Hay racks are not necessary with single-tier, flat deck layout, because hay can be spread on the tops of the cages where it is easily reached by the rabbits inside.

NEST BOXES

Whatever style of nest box is used, it should provide privacy for the doe at kindling as well as comfort and protection for the young. It should be simple to clean and maintain, well-drained and well-ventilated.

Nest boxes can be made from many designs and a variety of materials: wood, masonite, wire, sheet metal or a combination of these materials. They may be constructed at the rabbitry or purchased from suppliers of rabbit, equipment. Some nest boxes on the market are made of galvanized metal with disposable cardboard liners. Metal nest boxes lined with cardboard may be drier, but are drafty in winter. Wooden boxes cost less and may be warmer, but they have to be carefully disinfected.

A typical nest box design is 30 cm (12 in.) deep by 30 cm (12 in.) wide by 45 cm (18 in.) long, with the front end cut down to about 15 cm (6 in.). Though does seem to prefer covered nest boxes to open ones, covered boxes are more damp and difficult to sanitize as well as awkward to inspect. A sheet of cardboard or an empty feed bag placed over the cage may be enough to make a fretful doe feel more secure.

Lining the nest boxes with straw, shavings or shredded newspaper is necessary. (Any nonedible absorbent pliable clean bedding will do.) In winter additional

insulation and the use of heat lamps above the nest boxes may also be required.

Sunken nest boxes are becoming more common. The tops of such boxes are flush with the bottom of the cage. These are said to prevent losses of young rabbits that crawl out or are carried out of the nests since they fall back in easily. Sunken plastic nest boxes that pull out from under the cages like drawers are currently being used in Europe with success. Such counterset nest boxes provide a more natural environment for rabbits, which are burrowing animals.

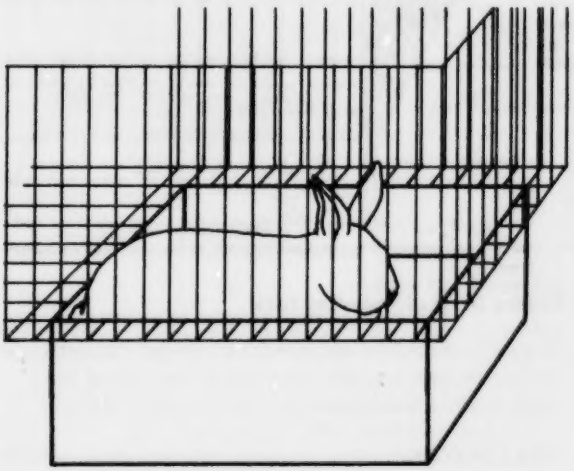


Figure 17. Sunken nest box

One problem with all nest boxes is that the urine of the young cannot be totally removed. The resulting dampness can lead to chilling of the young, conjunctivitis, stained fur and coccidiosis. The floor of the nest box can be modified by building a wire mesh floor raised about 6.5 cm (2.5 in.) and adding a loose layer of wood shavings below the wire to insulate the bottom against cold and to absorb the urine. This reduces the likelihood of these problems.

If the doe has a particular corner of her cage in which she defecates or urinates, the nest box should be placed in a different corner.

OTHER EQUIPMENT

Cleaning and disinfecting equipment

Propane torch to burn accumulated hair from cages

Carrying cages

Scale

Shovels and a wheelbarrow

Tattoo kit

Table or workbench

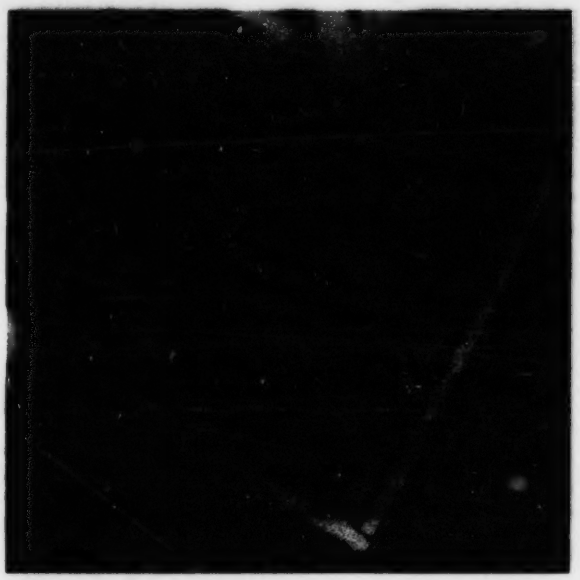


Figure 18. Wire-bottomed nest box

Assorted hand tools for maintenance and repair

Feed measures

Fire extinguisher(s)

Record cards

Nail clippers

BASIC EQUIPMENT COSTS (1981)

The costs of assorted pieces of rabbit equipment vary considerably depending upon whether they are purchased from rabbitry suppliers or whether they are constructed by the rabbit producer.

Cages:

Standard size (75 cm × 90 cm × 45 cm)	
to buy:	$23.00
to make:	$13.00

Feeders:

Regular feeders:	$ 3.00 each
Creep feeders:	$ 6.95 each

Watering Systems:

Unbreakable crock:	$ 4.00
1.1 L (1 qt) bottle waterer:	$ 2.85
Pressure regulator:	$28.00
Pressure reducing tank:	$60.00
1.3 cm (½ in.) PVC pipe per foot:	$ .20
Assorted hardware including "dew drop" valves:	$ 3.00-$ 4.00 per cage

Nest Boxes:

wooden (to buy):	$ 3.95
disposable liners:	$ 1.00

VI. RABBIT NUTRITION

The specific nature of the digestive system of the rabbit, the nutritional requirements of the rabbits and the nutrients supplied by available feedstuffs are all important factors in rabbit nutrition.

DIGESTIVE SYSTEM OF THE RABBIT

The digestive tract of the rabbit consists of a succession of organs found in all monogastric (single stomached) animals: mouth, esophagus, stomach, small intestine, cecum, colon and rectum. The rabbit is different from other monogastric animals in that the relative sizes of these organs differ greatly from those of other domesticated animals. The greatest difference is the considerable size of the cecum in the rabbits, which suggests that this organ is very important to the rabbit's digestion.

Like the first stomach of a ruminant, the cecum is the site where microbial fermentation of fibre occurs. However, the cecum of the rabbit is located so far along the digestive tract that to benefit from microbial action in the cecum, the rabbit must reingest directly from the anus. The name given to this process of recycling the soft feces in the cecum is *coprophagy*. Generally coprophagy takes place at night during the period of greatest calm.

It is estimated that 25-30% of the feces produced by the rabbit are soft pellets from the cecum, and almost all of the soft feces are reingested, making it possible for the rabbit to benefit from the vitamins (especially the B complex vitamins) synthesized in the cecum. These night feces are also a source of crude protein and some minerals.

Coprophagy has been observed in rabbits from the age of 20 days. This age coincides with the time the young leave

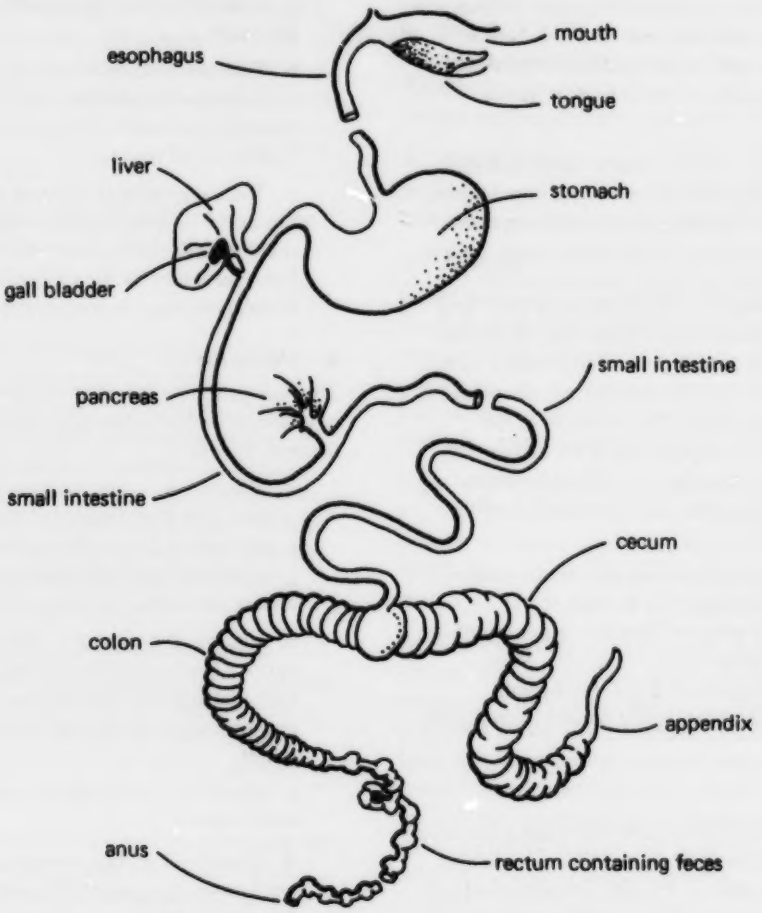


Figure 19. Digestive tract of the rabbit

the nest box and begin to consume solid food. At this age the cecum increases in size considerably. Coprophagy is essential in the digestive process of rabbits, enabling them to get the greatest amount of nutritional benefit from the food they consume.

NUTRITIONAL REQUIREMENTS

Not a great deal is known about the nutritional requirements of rabbits, however, studies are being conducted in all aspects of rabbit nutrition in various centres around the world.

The nutrients known to be essential to rabbits can be grouped into five categories. There are varied opinions as to the actual amounts of the individual nutrients required.

1. *Energy*

The requirement of rabbits for energy has not been fully determined. It is known that as the dietary requirement for energy increases, feed intake will increase. Primary sources of energy are carbohydrates and fats. Some energy is also derived from the breakdown of protein when more protein is eaten than the body requires.

a. Carbohydrates

In practical diets for rabbits, soluble carbohydrates and fibrous carbohydrates are the most important sources of energy. Starch (a soluble carbohydrate) is found in large amounts in cereal grains (oats, barley, wheat, corn). Fibrous carbohydrates (found in forages) are important to rabbits because their long digestive tract enables them to make use of fibrous feeds. Some fermentation of fibre takes place within the cecum and this, plus the process of coprophagy, makes the nutrients in the fibre available to the rabbits. Although the digestibility of crude fibre by rabbits is relatively low, a level of 12-14% seems essential for rabbits to maintain intestinal condition.

b. Fat

Fat is a concentrated form of energy that contains more than twice the digestible energy of carbohydrates and protein. Specific requirements for fat have not been established for rabbits. Most commercial rations contain 2-3% fat though indications are that rabbits could benefit from higher levels.

2. *Protein*

Protein is one of the most important and most expensive nutrients in the rabbit diet. It is required for growth and the production of body tissue. Protein is made up of sub-units known as amino acids. There is still a great deal of controversy as to which of the 20 naturally occurring amino acids are required by rabbits and at what levels.

Protein is found in most major feedstuffs. For rabbit rations protein is obtained from legume hays (alfalfa, clover), linseed meal, soybean meal, wheat bran, cereals and pasture grasses. The United States National Research Council (NRC) recommends that rabbit rations contain 16% crude protein during growth, 12% for maintenance, 15% during gestation and 17% during lactation.

3. *Minerals*

A number of inorganic elements are required for normal functioning. The major elements required by rabbits are:

a. Calcium and phosphorus — These minerals are required in relatively large amounts for growth, reproduction and lactation. Sources of these minerals are bone-meal, legume hays, green forage and cereal grains. (NOTE: Excess calcium is excreted by rabbits in their urine in the form of calcium carbonate, which causes the urine to become thick, white and creamy. The condition is not harmful to the rabbit.)

b. Sodium, chlorine and potassium — These minerals are required to maintain body pH (acid-base balance) and control the water level in the tissues. Salt is a chief source.

c. Trace elements (i.e. those required in minute amounts) — iron, copper, magnesium, iodine, manganese, zinc, cobalt, selenium, and sulphur. Each serves a specific function within the body and is usually obtained in the regular diet.

4. *Vitamins*

The vitamins are a group of nutrients which help the body regulate growth processes, assist in digestion and help prevent disease.

a. Vitamin A — This vitamin promotes health and growth. It is found in green grass, carrots, milk, well-cured legume hay, yellow corn and cod liver oil. It is generally added to the diet in a synthetic form to ensure potency.

b. Vitamin B complex — The requirements for the various B vitamins are partially satisfied by the bacterial action in the cecum. The process of coprophagy makes these vitamins available to the rabbit.

c. Vitamin C — No dietary requirements have been determined.

d. Vitamin D — The amount required by rabbits is not known, but a complete lack of this vitamin in the diet will lead to rickets. Good sources are milk, grasses and greens, well-cured hays and synthetic forms.

e. Vitamin E — This vitamin is essential for growth, gestation and lactation.

f. Vitamin K — Indications are that Vitamin K is required for normal reproduction but not for growth.

5. *Water*

Water is perhaps the most essential element of the diet because all vital bodily processes depend on it. Without water, rabbits will die. A restricted water supply will decrease the amount of food the rabbit consumes (and thus its growth rate), reduce the milk supply of nursing does and may cause the rabbit to develop digestive disorders.

It is estimated that an adult New Zealand White rabbit drinks about 280 ML (10 oz) of water daily; a doe near kindling may consume twice that amount. In hot weather a lactating doe together with a large litter approaching weaning may consume a total of 4.5 L (1 gallon) of water daily. Under heat stress, a rabbit's water intake will increase drastically. On the other hand, rabbits will drink more water than normal during cold weather because they are likely consuming more feed. It is essential that a good supply of clean, fresh water be available at all times.

FEEDSTUFFS

Rabbits can consume many different kinds of feed. The feedstuffs selected for inclusion in rabbit rations are determined by availability, cost and quality.

1. *Forages*

If given a choice, rabbits prefer legume hays such as alfalfa and clover above other hays. The grass hays such as timothy are less palatable and may contain only half the protein of legume hays. Rabbits seem to use the protein in alfalfa very efficiently. The fibre it contains, thought indigestible, helps the rabbit to maintain growth by keeping the intestinal wall healthy. This fibre may also be responsible for protecting the rabbit from the invasion of organisms responsible for mucoid enteritis. (See section 10: Disease and Abnormalities).

Alfalfa is one of the richest sources among available feedstuffs in Alberta of vitamin A and calcium. A mixture of 80% grain and 20% alfalfa meets the calcium and phosphorus needs of the growing rabbit. It is estimated that diets containing 20% alfalfa yield the best growth rates and offer protection from enteritis.

Today there are arguments both for and against using hay to supplement pellet feeding. Those who feed hay to their rabbits argue that the hay provides an additional source of crude fibre that may be lacking in commercial pellets. They also maintain that hay helps cushion young rabbits against digestive upsets and adds bulk to the digestive system. Others argue that feeding hay in addition to pellets creates extra labor and mess. They also argue that hay of poor quality may throw the ration out of balance and create deficiencies. There is also the possibility of the hay being contaminated by other animals. In any event, all hay fed to rabbits should be of good quality, dry and free from mold and noxious weeds.

2. *Grains*

Studies have shown that, given the choice, rabbits prefer wheat and barley to corn. Despite the high energy value of corn, rabbits do not perform as well on this food as they do on other cereal grains. In contrast, oats give a better response than would be predicted from its lower energy content. Rabbits may prefer fibrous grains such as oats because of their palatability. Buckwheat, rye, flax and sunflower grains have also been used as energy feeds.

To prevent waste and to encourage utilization by the rabbits, grains should be rolled, cracked or ground before feeding. Milled wheat products and by-products from manufacturing foods from other grains may also be fed. Rabbits do not usually chew whole grains sufficiently to receive full nutritional benefits from them.

3. *Protein Feeds*

Soybean meal has been used as a protein source in rabbit rations for many years. Canola meal can also be used.

4. *Greens*

Greenfeeds are not generally used by commercial producers because growth rates are diminished and labor requirements are high. Greens, however, may be considered by backyard or small scale rabbit producers who wish to reduce their purchases of commercial pellets and who have the time and labor available.

If greens are used they should be fresh and fed regularly, e.g. late every morning. Greens obtained from green grocers or market gardeners should be thoroughly washed to remove chemical pesticides. All uneaten greens should be removed from the cages daily.

Studies show that rabbits become more selective in their choice of greens as their supply of commercial pellets increases.* Red clover leaves and flowers seem to be preferred above all other greens. Nevertheless, the raiser feeding greens to rabbits should attempt to provide a variety. Some plants such as cabbage can cause goiter if fed in large quantities for a prolonged period. Root crops such as carrots, turnips and beets can be fed in the winter when fresh greens are unavailable.

---

* L. M. Pote, P. R. Cheeke, N. M. Patton, "Use of Greens as a Supplement to a Pelleted Diet for Growing Rabbits", *Journal of Applied Rabbit Research* (OSU 1980), Vol.3, No. 4, p.15.

KINDS OF FEED AND METHODS OF FEEDING

The caged rabbit cannot forage and select its diet as its wild counterparts do. The domestic rabbit is totally dependent upon the producer to provide balanced rations in satisfactory amounts. The producer must evaluate the method of operation and decide on a feeding program that is complementary to it.

Home Mixed Rations

Should the producer decide to feed grains and hay, consideration of cost, availability of feedstuffs, mixing equipment and the storage space required must be taken into account. Rations must include salt, supplementary protein, a mineral supplement and vitamins. Producers choosing to mix their own rabbit rations will find that such feed is best utilized if it is properly mixed and fed fresh to the rabbits. Such rations can be fed as a single diet or with the forages separate from the feed mixture.

The rabbit raiser feeding home-mixed rations must experiment with the amounts to be fed to rabbits in various stages of growth and development. Suggested rations for various sizes of rabbits are as follows: *

	Ingredients	% of Rations
For growing rabbits (0.5 - 4 kg) (1 - 8.5 lb)	Alfalfa hay	50
	Oats	17
	Barley	22
	Wheat bran	5
	Soybean meal	5
	Iodized salt, minerals & vitamins	1
		% 100
For maintaining does & bucks (Average weight 4.5 kg) (Average weight 10 lb)	Legume hay	70
	Oats	29
	Salt & micro mix	1
		% 100
For pregnant does (4.5 kg average) (10 lb average)	Alfalfa hay	50
	Oats	45
	Soybean meal	4
	Salt & micro mix	1
		% 100
For lactating does (4.5 kg average) (10 lb average)	Alfalfa hay	40
	Wheat	25
	Barley or oats	22
	Soybean meal	12
	Salt & micro mix	1
		% 100

It is suggested that for maximum growth of fryers, feed should be provided free choice (i.e. constantly available) but not wastefully. Pregnant does can be fed in the same way, but they must be watched closely so that they do not become overweight. Bucks and does being maintained should be kept lean by feeding them approximately 70 g (2.5 oz) of home mixed ration, plus free choice hay. Lactating does will likely require 85-140 g (3-5 oz) of the ration plus free choice hay daily.

* Rations are similar to those recommended by the NRC (1977). The Micro Mix should include levels of minerals and vitamins to complement those analyzed in the grain, forage and protein meal.

Commercial Feeds

Most rabbit raisers depend upon a commercial feed mill for their supplies of rabbit rations because of the availability of the product, the ease of handling and the reduced storage requirements. The higher cost of commercially prepared feeds is offset by savings in labor. Most rabbit rations manufactured commercially are general purpose diets formulated to meet minimum standards established by the National Research Council. No two commercial feeds will be the same in content, however, so it is up to the rabbit raiser to evaluate each ration against the herd requirements before a selection is made. Some feeds sold as "incomplete" feeds must be supplemented with alfalfa hay. The incomplete feeds are generally all-grain pellets consisting of cereal grains, their milled by-products, protein supplements and salt. "Complete" feeds include good quality ground hay in the pellet.

Pellets should be 0.5 cm (0.25 in.) in diameter and about 12 mm (0.5 in.) long; if they are too long there will be considerable waste by young rabbits. The pellets must be hard enough to avoid being crushed under normal conditions of storage and handling. Using a high level of alfalfa tends to produce soft pellets with large amounts of fine material.

The quantity of commercial pellets fed to the rabbits depends in part on the quality of the feed. Commercial pellets vary in protein content depending on their intended use: 12-15% (protein content) pellets are available for maintaining does and bucks; 16-20% pellets are available for gestation, lactation and growth.

The composition of pelletized rations varies as can be seen in the analysis of ingredients of two commercial feeds. The first, Feed A, is a high energy/low fibre feed; the second, Feed B, is low energy/high fibre.

Feed A	Ingredients	% of Ration
	barley	25.0
	oats	20.0
	dehydrated alfalfa	25.0
	beet pulp	5.0
	soya meal	17.5
	tallow	0.5

	lignosal (binder)	0.7
	IMC DiCal phosphate 18-20	2.0
	calcium carbonate	1.0
	salt	0.3
	premix 5	0.5
	molasses	2.5
		%100

Feed B	Ingredients	% of Ration
	sun cured alfalfa meal	52.90
	soya meal	20.60
	wheat mill run	19.60
	trace mineral salt	0.49
	dicalcium phosphate	0.25
	molasses	2.96
	tallow	1.20
	bentonite (binder)	2.00
		%100

The grower may decide to use a different feed for each stage in a rabbit's development with the amount fed remaining relatively constant. Or the grower may choose to limit the number of rations to one feed and vary the amounts fed to the rabbits according to their stage of development and physiological state. Depending upon the protein content of the feed, daily amounts fed should be as follows:

Rabbit Feeding Program

Bucks	85-112 g (3-4 oz)
Resting does	85-112 g (3-4 oz)
*Pregnant does	168-224 g (6-8 oz)
Lactating does	up to 454 g (1 lb)
Fryers	all they want

* Amounts should be increased gradually to attain the maximum quality just prior to kindling.

Whatever kind of ration (commercial pelletized or home mixed) is fed to the rabbits, the amount required depends on the individual rabbit. Too much for one rabbit may not be enough for another. When determining the amounts of feed required for optimum growth by rabbits, the producer must carefully weigh the feed and keep records of feed consumption and rates of growth. Feeding either too much or too little can be very costly: the cost of feed is one of the largest expenses in any rabbit raising operation. Good feed control is a sign of good management.

MEDICATION OF FEEDS

Some breeders provide medicated feed for their herds on a continuous basis in an attempt to maintain a low level of disease (such as coccidiosis). Other than treating rabbits for a specific ailment in times of need, the long term indiscriminate use of medication in feeds is not advisable, for the rabbits may become resistant to the drug. Rabbits intended for human consumption should be withdrawn from all medication for a minimum of five days before slaughter or according to the manufacturer's directions. Specific diseases may be treated with medication administered in feed or water, or by injection. (See section 11: Management).

FEED STORAGE

Feed should be stored in an area separate from the area where the rabbits are raised. The feed must remain cool, dry and free from vermin. Pelletized feed stored in paper sacks remains clean until the time of use. Grain or pellets in bins are especially susceptible to damage by mice. If hay is used, it is best if stored in a protected location so that it does not deteriorate in nutritive value. Feed should be used while fresh and in good condition. Storing hay indoors lessens infestation by vermin and offers protection from cats and dogs who can infect the hay with tapeworm cysts.

NUTRITION AND DISEASE

A carefully balanced diet is essential for rabbits subjected to the conditions of intensive production. Rabbits pushed to fryer weight too quickly may suffer from enteritis caused by *carbohydrate overload*. According to the theory of carbohydrate overload, when a high level of energy from soluble carbohydrate sources is fed in the diet, excessive quantities of starch reach the cecum and the colon, allowing rapid proliferation of bacteria. This rapid build-up in numbers of pathogenic bacteria leads to enteritis. Diets high in grain and low in fibre promote an increased incidence of enteritis, while diets containing no grain have produced no enteritis in studies to date.*

Particle size of the feed may also be important. Larger particles are moved rapidly through the digestive system while smaller particles are retained. The retention of small particles of grain could stimulate further bacterial growth leading to enteritis.

If the rabbit is not capable of handling high energy diets, then its growth rate cannot be pushed beyond a certain level. Low-energy, high-fibre diets reduce the growth rate

* P. R. Cheeks & N. M. Patton, "Carbohydrate Overload of the Hindgut — A Probably Cause of Enteritis", *Journal of Applied Rabbit Research* (OSU 1980), Vol. 3, No. 3, p. 20.

and increase the feed conversion ratio, both factors that may lower profitability. Improving the growth rate by increasing the carbohydrate level in the diet may increase the risk of losses due to enteritis. Some compromise may be necessary. For example, the rabbit producer might find it more efficient in the long run to feed his fryers longer using more low energy feed than to push them with a high energy diet and suffer losses from enteritis.

Perhaps as many as 50% of all the known rabbit diseases may be related to nutrition. Even in those diseases where bacteria or viruses have been shown to cause the disease, the nutrition of the rabbit at the time may be a major factor contributing to the length and severity of the illness.

There are a number of well-known nutritional deficiency diseases. For example, a deficiency in vitamin E is known to cause muscular dystrophy. Most vitamins used in commercial feeds are synthetic rather than natural. Occasionally the levels used are inadequate. Furthermore, synthetic vitamin E can be destroyed by the heat of the pelletizing process. The quality of the alfalfa used in the pellets can vary as well. Despite these potential drawbacks, it is still more efficient to buy commercial feed than to attempt to formulate and pelletize rations on a small scale. One must choose the best rations available for the rabbits and treat that feed as the basis for production. With good management practices, one should meet with success.

CHANGING RATIONS

The rabbit's digestive system, though able to handle a wide variety of feedstuffs, is sensitive to change in diet. This sensitivity is most evident when a rabbit raiser notices digestive problems appearing in the rabbitry following a decision to change commercial pelletized rations. Problems may also be encountered when a new batch of pellets of the brand regularly being fed is introduced.

Because different feed companies use different feedstuffs to meet NRC requirements, feeds may differ significantly in content although they contain similar levels of the necessary nutrients. Economic conditions frequently govern the ingredients used in rations. Changes from one year's crop to the next and the conditions at the feed mill at the time the feed was prepared affect the composition of the ration. The quality of one batch of feed will, for the most part, be consistent with that of another, but the differences in ingredients may vary. To help the rabbits make the transition from one feed or batch of feed to another without stress, the raiser should mix both lots of feed together, gradually decreasing the proportion of the old feed as the amount of new feed is increased. This management of the feeding program puts the rabbits' digestive tract under less stress and allows the animals to adapt to the new feed with a minimum of setback.

VII: REPRODUCTION

FERTILITY

Rabbits do not show regular estrus (heat) cycles, that is, specific recurring periods of sexual receptivity. Generally rabbits breed throughout the year, though there may be a seasonal winter depression. The doe remains fertile for long periods of time. If she is not bred, the egg follicles in the ovary remain large and healthy for a period of 12 to 16 days, after which they atrophy. Meanwhile, new follicles grow to replace them. As a result, active follicles are present at all times. There may be a transitional period, while the new set of follicles is growing and the old set is diminishing, then the does may lack interest in the male and be temporarily sterile. However, because the rabbit raiser cannot determine the exact stage of follicle growth, it is best to presume that the doe is fertile at all times.

Rabbits are induced ovulators: ovulation (the process of shedding eggs) does not occur in the female unless she has been sexually stimulated. Following mating the follicles in the ovary begin to grow rapidly. They break, releasing the eggs about ten hours following mating. During this time the sperm from the male are moving through the female reproductive tract to the upper part of the Fallopian tubes, where they fertilize the eggs. The fertilized eggs then grow into fetuses which develop in the uterine horns.

GESTATION PERIOD

The gestation period or the period of time from mating to kindling (giving birth) is 31 to 32 days. Young may be born earlier or later than this time. However, if kindling is delayed two or three days, the reason may be that one or more of the fetuses is unusually large.

AGE TO BREED

The proper age of bucks and does for mating is dependent upon both breed and individual development. Smaller breeds develop more rapidly and are sexually mature at a much younger age than are medium weight or giant breeds. The commercial breeds such as New Zealand Whites and Californians are bred at 4.5 to 6 months of age. Females generally mature earlier than do males.

Often a doe will show signs of receptivity at three months of age, but she has not yet reached the size or the condition to handle the stress of pregnancy. Very young mothers often do not care for their young.

Some strains of commercial rabbits breed at four months of age; others at five. With time, the breeder comes to recognize the optimum age to begin mating particular rabbits. The age to begin mating is crucial, for the doe must be bred before she has the chance to develop an abundance of internal fat. Once internal fat develops, it is very difficult to eliminate. Breedable does that have not been bred become more reluctant to breed as time goes on.

Before actual mating takes place, the bucks and does should be thoroughly inspected for health, fitness and maturity. The mature buck should be well developed, fit but not fat, bright of eye, with good appetite, energetic and not at all sluggish or dull. Both testicles should be completely descended into the scrotum, and the scrotum should be full and large. If one testicle has not yet descended, the condition may be but a temporary one. In this case the buck should not be used and his development further observed. A buck with withered or wrinkled-looking testicles may be temporarily or permanently sterile.

A mature doe should also be in good condition with a shine to her coat and bright eyes. A doe in the peak of mating condition will raise her tail if she is stroked across the back and shoulders. Another sign that a doe is in a receptive stage for mating is that her vulva will be congested and reddish to purplish. She may show signs of restlessness or nervousness and a desire to be with other rabbits. She may rub her chin frequently on the cage or utensils. These are but indications; the only recourse for the producer is to place the doe with the buck and to observe the reaction.

MAKING MATINGS

The most favorable times of the day for mating rabbits are early morning or late evening, particularly in hot weather when rabbits are reluctant to breed. It is also advisable to mate rabbits before they are fed, for hungry rabbits are more alert than are full-stomached ones. It is vitally important that the matings take place in a calm, quiet atmosphere without rush or rough handling.

A doe should always be taken to a buck's cage for service. Does tend to be territorial, and a doe will often attack and injure a buck that is placed in her cage. Furthermore, if a buck is put into a doe's cage, his first instinct is to check for the scent of other bucks. If none is found, his second instinct is to mark the territory as his own with musk which is produced in two glands beneath his chin. Only then will he feel comfortable with the mating ritual.

There are four methods for mating does:

1. Natural Mating

Natural mating is the best method and gives the highest conception rate. The doe should be placed in the buck's

cage with her back to the buck. She is then positioned for the buck to mount her quickly and accurately, saving the doe from stress and the buck from frustration. A receptive doe will raise her hindquarters and throw up her tail to permit entry by the buck. Upon contact, the buck ejaculates almost immediately. (The mating may be accompanied by a cry from either animal.) After the act of mating, the buck may fall over on his back or his side.

The doe should be removed from the buck's cage immediately after mating. She should be carried, vent upward to retain the semen, back to her own pen. Reluctant does may be successfully mated if they are returned to the buck's cage within six hours following the first attempt at mating.

2. *Forced Mating*

If the doe will not accept service, she may be restrained for mating. This method is particularly helpful in the mating of rabbits for the first time. If the buck chases the doe around the cage but she resists his advances, she must be restrained to accomplish mating. Generally an experienced buck will be more successful in mating a maiden doe than will a young buck.

When restraining a doe for forced mating, the handler faces the doe and uses one hand to hold on to her ears and the fold of skin over her shoulders. The other hand is placed under her body and between her hind legs. The thumb of this hand is placed on one side of the vulva and the index finger on the other side, gently pushing the skin backward. This procedure throws the doe's tail up over her back. The handler supports the weight of the doe with the underhand and elevates the hindquarters to the normal height for service. The buck will mount the doe, which is now in a receptive position, and the service will take place. Rabbits accustomed to being handled will not object to such assistance.

3. *Confined Mating*

Another method of mating an uncooperative doe is to leave her with a buck for a few hours or overnight. It is presumed that she will gradually grow accustomed to the buck over this period and will become receptive. The major drawback to confined mating is that it is time consuming, and unless the breeder sees the actual mating, there is no guarantee that the doe has actually been bred. Furthermore, when left together the rabbits may fight and injure each other.

4. *Artificial Insemination*

Artificial insemination has been practised with rabbits for experimental purposes but has not yet been applied to rabbit breeding to any extent. Semen is collected from the bucks by means of an artificial vagina and then introduced to the females. Because the rabbits will not ovulate unless sexually stimulated, it is necessary to give the does an injection of hormones about six hours prior to insemination. It is doubtful that artificial insemination will ever replace the stud buck, but it has its uses during periods of lowered fertility or when there is an urgent need to test a buck on several does simultaneously. Technical problems tend to prohibit the use of artificial insemination as a practical tool of the industry.

DETERMINING PREGNANCY

Contrary to popular belief, determining pregnancy by test mating (i.e. placing the doe with the buck to see if she will again accept service) is not a reliable method. Some pregnant does will accept the buck, and some nonpregnant does will not. A more assured method of determining pregnancy must be used if the producer is to rebreed promptly those does that fail to conceive and if feed levels for pregnant does are to be adjusted. Such a method is *palpation*.

Palpation means that the abdomen of the doe is examined by touch to determine the presence of fetuses in the uterus. It is an accurate and quick test performed 12 to 14 days following mating. At this stage the fetuses have developed into chains of marble-shaped forms on either side of the midline of the abdomen. As the fetuses grow, however, they rise into the abdominal cavity and may be mistaken for internal organs. Also, earlier in pregnancy the embryos may be mistaken for fecal pellets or vice versa. Palpation is, therefore, a skill perfected by experience.

Does may be palpated in their cages or placed on a nonslippery surface at a convenient height for the handler. Calm does, used to being handled, are the easiest to palpate. The doe is stretched out on the table facing the handler. She is restrained by grasping her ears and a fold of skin above the shoulders with one hand while placing the other hand under the body between the hind legs and slightly in front of the pelvis. The thumb is placed on one side and the forefinger on the other side of

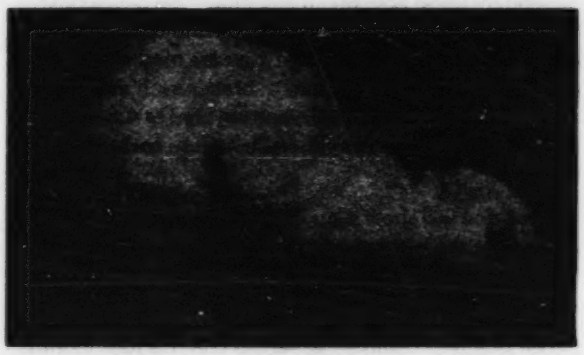


Figure 20. Palpating

the uterine horn. The fetuses should now be distinguishable as chains of grape-shaped forms that slip easily between the thumb and fingers. Gentle handling of the doe is required. If too much pressure is exerted, the tissues may be bruised or torn loose from the uterine walls, and the doe may abort. The novice breeder should palpate on day 14, beginning on an experienced doe. Young does have very firm belly muscles, making palpation more difficult. As experience is gained, the date of palpation may be brought forward to as early as day 10.

It is obvious that financial gains are to be realized from palpation in that the proficient breeder can make an earlier diagnosis of missed matings and can immediately have the does rebred.

VIII: BREEDING PROBLEMS

It is commonly believed that rabbits are among the most prolific breeders in the animal kingdom, and as a result of this assumption, persons contemplating becoming rabbit breeders envision myriads of offspring produced by one adult pair. But what a pair of adult rabbits seem able to produce in theory is often not true in practice, for a number of conditions may arise to inhibit conception.

PSEUDOPREGNANCY

Sometimes a doe may give indications of being pregnant, even to the point of producing milk and making a nest, and yet not be pregnant. Such a false pregnancy may be caused by infertile mating or sexual stimulation when one doe rides or is ridden by another. Following such stimulation the doe releases egg cells, causing the uterus to increase in size in preparation for accommodating the fertilized eggs and activating the mammary glands. Ovulation cannot take place until the hormone secretion has dissipated: 17 days following the stimulation which caused the pseudopregnancy.

The doe may indicate the termination of pseudopregnancy by pulling fur and attempting to make a nest. She will, however, make no attempt to keep such a nest clean. Palpation of the doe will confirm that she is not pregnant. The doe should readily accept the buck at this time with the union resulting in a true pregnancy because her fertility will be at its highest point at the end of the pseudopregnancy.

To prevent pseudopregnancy, the breeder is advised to separate young does that are to be mated three weeks before mating. They will then have passed through any false pregnancy period by mating time. Once a doe has reared her first litter, she is less likely to undergo pseudopregnancy if she has been kept active with an early remating system.

FACTORS THAT LIMIT CONCEPTION

There are times when rabbits will show no interest in breeding, or show signs of sterility. Sterility is a condition in which either sex is incapable of reproduction, either temporarily or permanently. A number of causes can limit conception in rabbits.

1. Physical Condition

Obesity is likely the major cause of breeding problems. Overweight rabbits tend to be lazy and not interested in breeding. An overweight doe may not always show signs of fat, for much of the fat is accumulated internally around the reproductive organs. Once a doe is in this condition, she is very difficult to breed. Similarly, overweight bucks may be lazy breeders.

Because it is so easy to overfeed the stock, particularly when rabbits seem hungrier with the approach of winter, rabbit producers should weigh their animals regularly to ensure that the animals maintain a constant weight. Breeding the does as soon as they are sexually mature and keeping them actively in production by remating them before their litters are weaned will keep them lean and fit.

2. Nutritional Deficiencies

Any rabbit that is underfed or given a diet that is nutritionally inadequate may be incapable of reproduction. Most commercially prepared rabbit feeds contain adequate amounts of the necessary vitamins and minerals.

3. Summer Heat

Breeding problems always increase in the fall and winter months. Although several factors are involved in the decrease in production which so many breeders experience in their rabbitries from September to mid or late January, one factor is summer heat. Bucks can become sterile in extremes of hot weather. The length of time the condition lasts will be directly proportional to the length of exposure to higher temperatures. This condition primarily affects adult males and has less effect upon the maturing male (5 to 7 months of age). When the temperature exceeds 29°C for several consecutive days, male rabbits remain sexually active but fertilization may not take place for about 60 days.

To prevent disruption in conceptions because of heat-caused sterility, the breeder should keep the temperature of the rabbitry below 24°C and plan to have young males available to replace the older males as soon as the older males suffer from heat stress. It is essential, therefore, to keep a daily temperature chart for the rabbitry and to avoid extreme temperature fluctuations. Once cool weather returns, mature bucks may be returned to service after a two-month rest.

4. Decreasing Daylight

Does are particularly affected by decreasing the hours of sunlight. Breeding problems become more frequent as the days start getting shorter, a situation often referred to as the "Fall Breeding Problem." The decreasing daylight triggers the natural urge of the rabbit to cease reproduction and to prepare for winter by growing a thicker coat and accumulating an insulating layer of fat around the internal organs. By late summer, the does may refuse the bucks entirely, and the bucks may also lose interest in servicing them. By mid January, the does are once more receptive to service as the daylight hours lengthen.

The problems of early winter slow-down can be alleviated somewhat by extending the rabbit's "day" with artificial

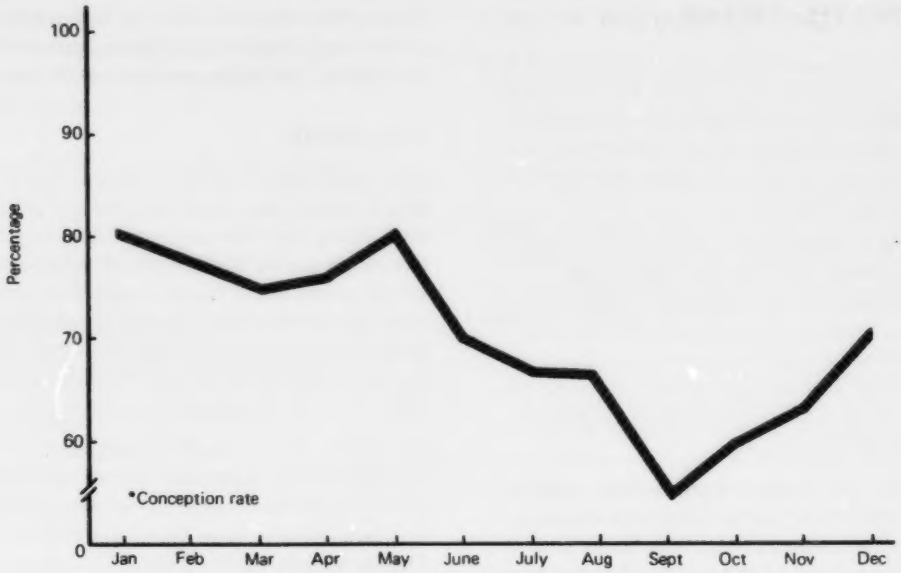


Figure 21. Effect of season on reproductive capacity*

light. The amount required will depend upon the latitude at which the rabbitry is located. The artificially lighted day should be no longer than the longest day of the year. Artificial lighting should be added in both the morning and in the evening, balancing the natural decrease in daylight. The fall breeding problem can also be overcome if the breeder brings the herd into the fall months in a state of intense productivity, because hormone levels are higher in producing does, and mating and conception rates are correspondingly higher when rabbits are kept in production.

5. *Inherited Factors*

Some rabbits are better breeders than are others. The tendency to a fall breeding slump or a low fertility rate may be inherited traits. The breeder must try to select animals that have hereditary traits for mating and conceiving readily the year round. Sluggish breeders should be culled.

6. *Moult*

In the wild, rabbits go through a summer moult (shedding of hair) that heralds the beginning of the barren period. Domesticated rabbits also go through a moult of varying intensity which may or may not affect their breeding capacity.

7. *Stress*

Stress is a situation of nervousness brought on by fright, exhaustion, injury, sudden temperature change, etc. that can affect breeding at any time. Some rabbits are easily disturbed while others are not. Stress can be reduced in part by selection and by good management techniques. (See section 10: Diseases And Abnormalities).

8. *Age*

Young does may not be sexually mature at the time of service, while old does may have passed their prime and failed to conceive. Does should reproduce satisfactorily and successfully nurse their litters if they are in good condition. In commercial herds, does that are properly cared for should produce approximately 15 litters. An exceptional rabbit may surpass that number.

9. *Disease or poor general health*

(See section 10)

10. Malformation or absence of any of the reproductive organs, e.g. undescended testicle.

NEONATAL DEATHS AND ABORTIONS

Both premature and term stillbirths are caused in the main by disease and poor nutrition. The doe may drop her young at an early date and show no further interest in them, allowing them to die from neglect. She herself may show signs of distress and die suddenly.

Sometimes a large bunny will get stuck in the birth canal and will suffocate. If it is stuck for any length of time, those bunnies remaining in the uterus will also suffocate and will be stillborn. Rabbit raisers are cautioned to treat pregnant does gently and to avoid making sudden movements or loud sounds that will distress them.

* H. L. Enos, D. D. Caveny. B. L. West, G. Heidbrink, "Equipment and Management Options to Facilitate Year-Round Rabbit Production", *The Domestic Rabbit: Potentials, Problems, and Current Research*. (OSU 1979), p. 38.

IX: RAISING THE LITTER

KINDLING

Kindling (giving birth) is a critical period in a doe's life. Every effort should be made to ensure that she is comfortable and prepared with proper nesting material prior to the delivery of her young.

A nest box should be placed in the doe's cage 27 to 28 days after she has been bred. The nest box should contain an absorbent, dust-free bedding material such as wood shavings or straw. Many pregnant does will grab some bedding in their mouths and run around the cage with it before settling down to make a nest from what has been provided. (Note: If the doe urinates in the nest box she may not be pregnant after all).

The day before the doe kindles she may refuse to eat but will drink freely. Most does kindle at night and resent interference. Just before the young are due to be born, the doe will complete her nest with a layer of hair which she pulls from her belly. The rabbits are born blind and deaf and almost furless. The doe will clean them and cover them with more fur from her abdomen. She will be nervous following kindling and should not be disturbed until she settles down.

CARE OF THE YOUNG LITTER

As soon as possible following kindling the breeder should quickly and quietly check the cage for babies left outside the nest. Young does may kindle on the wire or fail to pull fur to cover the newborn in the nest. If discovered in time the young may be saved by warming and being placed in the nest and covered with fur which the breeder can pull from the underside of the doe. Some breeders save extra fur from summer nests for supplementing the amount of fur required in colder months. A good doe, however, will provide adequate covering herself.

Figure 22. Litter in nest box

During this initial inspection the breeder should make a careful count for the record book. Litters may vary greatly in number: from as few as one to as many as 15.

FOSTERING

Most rabbit raisers will breed several does at the same time to ensure that more than one doe will kindle at one time. If one doe has a very small litter (e.g. 2 or 3 young), her young can be transferred to the nest of another doe whose young are of the same age. The first doe can then be rebred immediately. If a doe dies shortly after giving birth, her young can be fostered by other does, provided that the young of those foster mothers are no more than 48 hours older than those being fostered.

As a matter of course, some breeders foster rabbits from one healthy doe to another to even out the sizes of the litters raised. For example, a doe producing six live young may be given two more from a doe that produced ten. The decision to foster will depend upon the mothering ability and the milk supply of the recipient doe.

A doe may reject the young of another doe and refuse to enter her own nest box following the addition of new bunnies. If the doe seems nervous about the additional young, some vanilla extract can be put on her nose. By the time the smell of the extract has worn off, the new babies will have picked up the scent of the nest box and will be accepted by the doe as her own.

If the breeder is planning to save some of the fostered young as breeding stock, they must be marked for identification at a later date. A drop of tattoo ink applied under the skin of the ear with a hypodermic syringe is an efficient form of identification.

CAUSES OF LOSSES IN NEWBORN RABBITS

It is estimated that 20% of rabbit losses occur during the first eight weeks of life. Half of those losses occur during the first week of life. The major causes of death of the newborn are the following:

1. Chilling

If a doe is disturbed in any way — by loud noises, bright light, strangers or predators — she may kindle on the cage floor, and the young may die from exposure. Even if kindled in the nest box, the young may die from exposure due to low building temperature, drafts, poor nest boxes or inadequate nesting material.

2. Injury

If she is disturbed after the young are born, the doe may jump into and out of the nest box or stomp with her hind feet in the nest and thus kill or injure the newborn.

3. *Cannibalism*

Does, especially those producing their first litter, sometimes eat their young. Such cannibalism can have a variety of causes such as:

a. Lack of sufficient water for the doe prior to kindling

b. Fear

c. Accidentally nibbling the limbs of the young during birth.

d. Deficiencies in the doe's diet.

e. Inherited tendencies toward cannibalism.

Does generally do not kill and eat healthy young, but limit their cannibalism to stillborn or to those that have been injured and have died. Many rabbit raisers claim to have ended cannibalism by feeding potentially cannibalistic does a piece of bacon a day or two prior to kindling. Does that repeatedly eat their young should be culled from the herd.

4. *Starvation*

A young nervous female may not settle in to nurse her litter. Starving babies will be thin and dehydrated with empty stomachs. Such litters must be fostered within hours to be saved.

A doe that is herself unwell may not nurse her young. Pregnancy is physically demanding and lowers vitality, increasing susceptibility to disease. For example, near to or following kindling, a doe may develop pneumonia, with which breathing will be labored and the head held and tilted backward (see page 00). A sick doe must be encouraged to eat to keep up milk production and may be enticed with fresh greens. If the doe is not properly cared for, the rabbit raiser may lose both the doe and her young.

A doe with caked breast may refuse to nurse her young. Caked breast can result from injuries to the breast which block the milk flow. The breast becomes inflamed and hard. The tissue around the teats becomes enlarged, hard and very tender. Rubbing lanolin on the teats may keep them soft enough to allow the young to nurse if the doe is restrained. The inflammation will be relieved if the milk flow can be maintained.

Mastitis or "blue breast" will also interrupt nursing. This condition is caused by bacterial infection and may be very contagious. The doe loses her appetite and becomes inactive. Her breast becomes congested and hot and turns a dark red to purple; the teats are also discolored. Penicillin is an effective treatment.

CARE OF THE YOUNG LITTER

The importance of daily litter inspection must be emphasized. While the young remain in the nest box, they must not be ignored. The litter should be checked for injuries and deaths and counted to be sure that one or more have not become separated from the main body of the nest. The young should be quiet with round full bellies. Squirming active young in the first two weeks of life may not be receiving adequate nourishment. Reducing the litter number by fostering may result in better-fed young.

During the periods of cold weather, the breeder must check the nest to ensure that the young are adequately covered. Occasionally the doe will jump out of the nest box with a baby still attached to a teat. She will not return that baby to the nest herself. If the raiser discovers a young rabbit out of the nest and the baby appears dead, it may only be stiff with cold and can be revived and returned to the nest box. One of the surest methods for warming a baby that is unconscious with cold is for the handler to place it under an armpit until it is revived.

Young rabbits in nest boxes are also very susceptible to extreme heat, and such discomfort is characterized by extreme restlessness. The breeder may remove the fur covering from the nest box in the mornings and replace it at night. During the extremes of hot weather, young that have begun to grow hair can be removed from the nest boxes and placed on the wire of the cage floor until it is cool enough to return them to the nest box. A water-soaked sack spread over the cage above the nest box may also have a cooling effect.

Young rabbits usually open their eyes on the tenth day following birth. In some instances the eyes remain closed because of infection, usually caused by dusty bedding. If the lids are inflamed and encrusted they should be bathed with a 4% solution of boric acid applied with a clean cotton swab. When the tissues are properly softened the lids can be separated by slight pressure. Once the eyelid is opened, healing is rapid and any subsequent treatment is usually unnecessary.

LACTATION

The young rabbits remain in the nest box for 2.5 weeks, during which time they rely solely upon their mother's milk for nourishment. The composition of the milk will vary from one rabbit to another, but it is extremely rich. Such rich milk is essential for the rapid growth of the young rabbit in its early life. Rabbit milk contains more than twice the quantity of total solids as cow's milk, about four times as much protein and fat and three times as

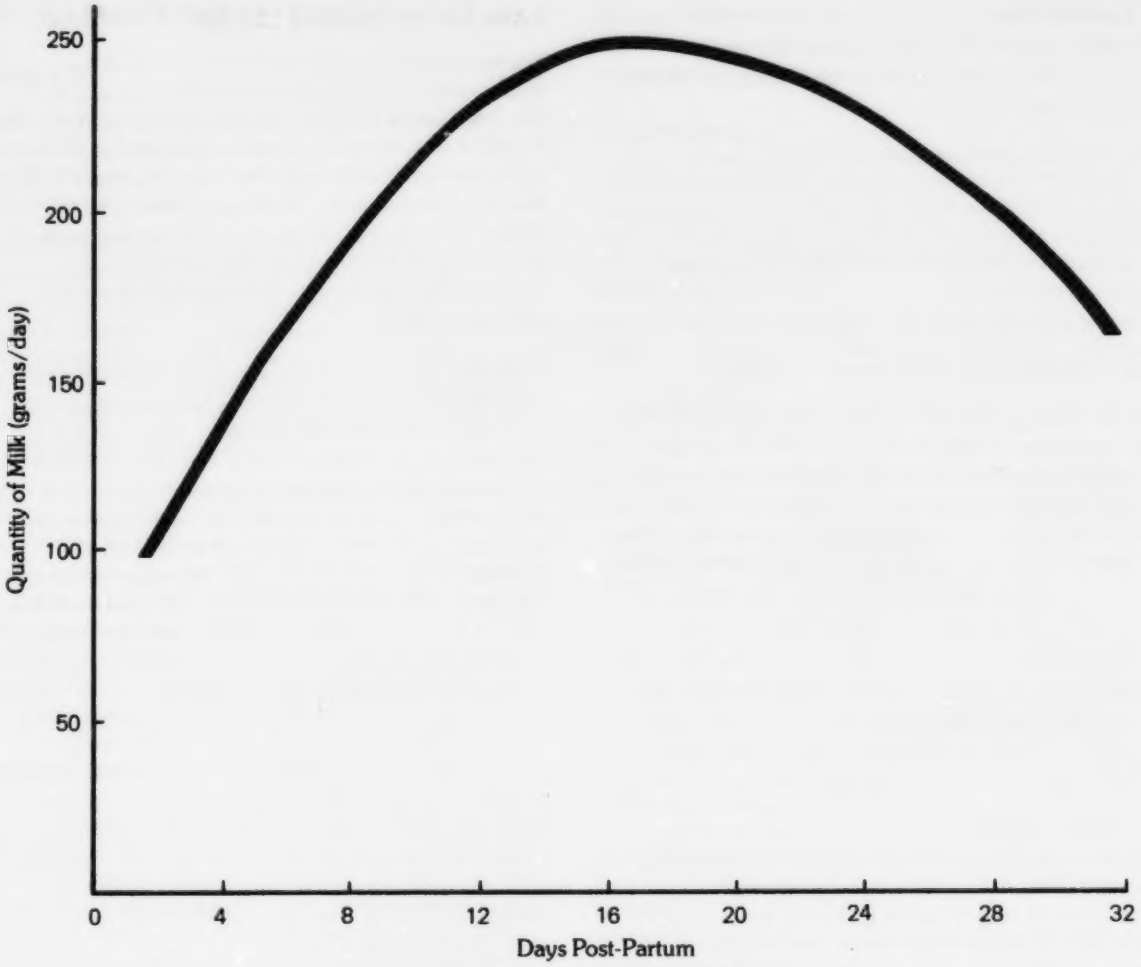


Figure 23. Milk production in does * *

much ash but only one-sixth as much lactose (milk sugar). *

It is obvious that the nursing doe must have proper nutrition if she is to supply adequate milk and maintain condition. It is important that a nutritional boost be given to the doe as soon as her pregnancy is determined, for the growth of the mammary glands which produce milk begins early in pregnancy. Because the most rapid growth of the fetus occurs during the last third of the pregnancy, feed should be increased during the second half of the pregnancy. (See section 6: Rabbit Nutrition.) By increasing feed during pregnancy, an improvement in post-kindling milk yield can be achieved.

The amount of milk produced varies throughout the lactation period but usually does not go beyond six or seven weeks. Maximum milk production is usually reached by the third week following kindling, after which production gradually declines.

The duration of lactation varies with diet, the number of suckling young and the length of time the young are left with the doe. The amount of milk produced depends upon the breed, strain, diet and genetic constitution, as well as the general condition of the doe, the mammary development and the demands of the litter.

It is imperative that the rabbit raiser determine the milk production of each doe. Weighing the young at 21 days when milk production is at its highest will give the breeder an indjcation of the quantity and quality of the lactation of the mother. Prior to this the breeder will check the young in the nest box to see that they are full-bellied and contented.

* Marjorie, E. P. Netherway, *A Manual of Rabbit Farming*, (London 1977), p. 39.

* * Gouvernement du Quebec, *Lapin de chair*, (1980), p. 14.

Does tend to nurse their nest box young in a single feeding every twenty-four hours, usually at night or early morning. After the young leave the nest box and are consuming solid food, they will still try to nurse several times during the day. The doe will usually push them aside, however, and restrict their nursing to the night time.

CAUSES OF LOSSES IN YOUNG OUT OF THE NEST BOX

Losses may occur at approximately 3 weeks of age when the apparently thriving young rabbits begin to leave the nest box and eat solid food. From three to ten weeks of age the most common cause of death is diarrhea or rabbit dysentery. The diarrhea is a symptom of a disease, not a disease itself, and often appears at times of stress such as weaning. In spite of treatment with antibiotics, as many as half of the infected rabbits will die. Losses are usually highest among those with the lowest body weight. Coccidiosis may be the underlying cause, although bacterial infections, viral infections and low diet fibre are also suspect.

Sometimes the deaths are epidemic in number and are extremely frustrating to the rabbit breeder. The maintenance of constant feed quality and a high standard of sanitation as well as the reduction of stress wherever possible are the best safeguards against losses of premarketable rabbits. The nest box, which itself harbors bacteria and sources of future trouble, should be removed from the cage 21 days following kindling. By this time all the young should have left it on their own to seek solid food and to exercise their muscles.

WEANING

The easiest way to wean the young is to leave them with the doe for 8 to 10 weeks until they can be taken directly to market as fryers.

Optimal weaning time will be determined by the particular breeding program followed. Under accelerated breeding programs it is advisable to wean the young in time to allow the doe a few days rest before the birth of her next litter. Heavy milking does may develop caked udders if the young are weaned abruptly. This condition may be overcome by leaving one or two young with the doe until her milk flow has decreased.

Young fryers appear to undergo a certain degree of stress when separated from their mothers, at whatever age. To minimize such stress, the producer should remove the doe to a clean pen and leave the litter in their own familiar pen until they are marketed.

X: DISEASES AND ABNORMALITIES

STRESS

Before considering the more common rabbit diseases and their treatment, one should be aware how stress affects the rabbit's well-being. Stress is generally defined as a pressure or strain caused by an adverse force. Stress occurs in all types of rabbits and may come from sources inside the rabbitry or from the external environment. Early signs of stress can be missed in the individual rabbit until the effect becomes severe.

Stress may arise from any of the following causes:

1. ***Environmental***

   a. *General treatment* — transportation, changes of pen, crowding etc.

   b. *Climatic Effects* — too great a variation in levels of temperature and humidity, drafts, seasonal temperature extremes, etc.

2. ***Physiological***

   a. Anything which upsets the function of the body such as lactation, pregnancy, kindling, changes in diet, excitability of bucks

   b. *Clinical Causes* — for example, the effect of illness, injury or infection.

3. ***Inherited***

Nervousness may be inherited in an excitable strain e.g. reaction to changes in noise level, new handlers, strangers.

Stress seems to be best tolerated by young rabbits: as rabbits grow older, the time taken for full recovery becomes longer. Stress puts great demands upon the animals, leaving them susceptible to invasion by disease.

DISEASES

Mucoid Enteritis

Enteritis or diarrhea is the number one killer of rabbits, accounting for 50% of the deaths from nest box to weaning in commercial rabbitries. The incidence of enteritis is very low until the fourth week of age; it peaks at seven weeks and declines sharply after eight weeks of age*. It may also affect does just before or just after kindling.

Causes of mucoid enteritis are not known; both viral and bacterial causes are suspected. Explosive outbreaks of mucoid enteritis have occurred with sudden changes in feed or management, or from carbohydrate overload. Signs of the disease are depression, loss of appetite, rough coat, squinting eyes, grinding of the teeth, a hunched-up position, bloated stomach and diarrhea. The feces may contain large amounts of white slimy mucous. The sick rabbit will be off in a corner by itself. As diarrhea and dehydration progress, the animal may lose 10 to 25% of its body weight in 24 to 48 hours.** Death occurs rapidly and few animals can be saved.

It is felt that mucoid enteritis can be partially prevented by the addition of indigestible fibre — hay, clover, blackberry leaves, straw — to the rabbit diet to keep up the vitality of the lining of the intestine.

There is no special treatment for rabbits afflicted with mucoid enteritis. However, chlortetracyclines and oxytetracyclines added to food or water have been effective in reducing losses.

Pasteurellosis (Snuffles)

Another disease common among rabbits is snuffles. It seems to appear in almost every herd sooner or later. Signs of the disease are sneezing, wet forepaws (from rubbing the nose) and a mucous discharge from the nose with crusty scabs sometimes present. The rabbits lose appetite and weight and become depressed and listless.

The disease is caused by a highly contagious bacterium which may cause disease forms other than snuffles. Treatment is very difficult and recurrence is common. Stress may also cause flareups. Antibiotics in the water or feed seem to be the best way to control outbreaks. Extremely good ventilation and sanitation practices are required to successfully prevent the appearance of snuffles. Ammonia build-up in a rabbitry from the accumulation of manure may also provide incubation for pasteurella organisms. Ammonia irritates the rabbit's membranes, creating ideal conditions in the nose of the rabbit for bacteria to colonize.

If left unchecked, snuffles may spread to the lungs and cause pneumonia. Pneumonia is the greatest cause of death in mature animals. Pasteurellosis may also cause various other conditions such as septicemia, peritonitis and subcutaneous abscesses. When medication fails to control the disease, it may be necessary to depopulate the rabbitry, clean and disinfect before introducing new healthy stock.

The use of pasteurella-free stock may be the best way to reduce the incidence of pasteurellosis in the long run, for it seems that once rabbits are infected they remain so to varying degrees.

* *Agriculture Handbook No. 490*, U.S. Department of Agriculture (1976), p. 30.

** Ibid.

Coccidiosis

Coccidiosis is the most common parasitic disease in domestic rabbits. It is caused by microscopic parasites that invade the liver and the lining of the intestine. Rabbits can tolerate mild infection from *Coccidia* without overt illness. Illness is caused by severe infection with these parasites.

Hepatic (liver) coccidiosis is usually not detectable in live rabbits. Affected rabbits may show slow weight gains. The parasites will appear as white spots in infected livers of slaughtered animals.

Intestinal coccidiosis, which is more severe, is evidenced by weight loss despite a good appetite, occasional diarrhea that is sometimes blood-tinged and pot bellies. In more severe cases, progression of the disease is so rapid that the rabbits die before the handler realizes that they are ill.

Coccidiosis is transmitted from one rabbit to another by fecal contamination of the feed, water and cage floors. The greatest source of contamination is the doe herself who carries and sheds the disease but appears healthy. Therefore, cage sanitation is a must. Sulfonamide drugs in the feed or water are reasonably effective against coccidiosis at the time of outbreak.

Rabbit Syphilis (Vent Disease)

The first signs of rabbit syphilis are usually small blisters, scabs or pustules around the external sex organs. As this bacterial infection progresses, similar sores may appear on the anus, eyelids, snout lips and even the hocks.

This disease is transmitted by direct contact and can thus be prevented if the genitals of both sexes are examined before mating. Animals with infected genitals should be isolated and treated with penicillin. A propane torch should be used to disinfect cages that have held infected stock.

Tyzzer's Disease

Tyzzer's Disease is caused by a bacterium. Though incidence of it is rare, it appears to be on the increase. Signs of the acute form seen in recently weaned rabbits are profuse watery diarrhea, listlessness, lack of appetite and dehydration, followed by death in 12 to 48 hours. Tyzzer's Disease can be confirmed only upon postmortem inspection wherein pin-point yellowish-gray spots can be seen on the liver.

Transmission of this disease is by direct contact with fecal-contaminated feed and bedding. Stress, such as extremes of temperature or overcrowding, may bring on the disease; thus good management and sanitation programs are emphasized once again. Antibiotics in the water may be helpful during outbreak.

Young Doe Syndrome (Y.D.S.)

A relatively new affliction which is spreading across North America is the Young Doe Syndrome which refers to the sudden death of young does following kindling. The features of this syndrome are as follows:*

1. It occurs in the first- or second-litter does.
2. Does die suddenly when the litter is two to four weeks of age.
3. The only symptom is reduced feed and water intake for one or two days prior to death.
4. About half the does show excessive salivation around the mouth.
5. About 80% reveal intestinal impactions predominantly located in the cecum.
6. The intestinal contents are non-toxic.

There are several theories as to the cause of Y.D.S. Though pregnant, the doe may not be up to full adult weight and size and may, therefore, not be capable of coping with the stress of producing her first litter or with the stress demanded by maximum lactation. Recently two basic causes of Y.D.S. have been advanced:

1. It is a systemic infection that follows staphylococcal mastitis, and can be treated with injections of potassium penicillin;
2. It comes from mismanagement which results in enterotoxemia.

High energy (grain) diets may result in carbohydrate overload which allows toxin-producing bacteria to proliferate rapidly. Because the liver cannot detoxify it fast enough, the rabbit dies. A suggested remedy is to increase the doe's feed gradually rather than suddenly following kindling, with higher additions of alfalfa.

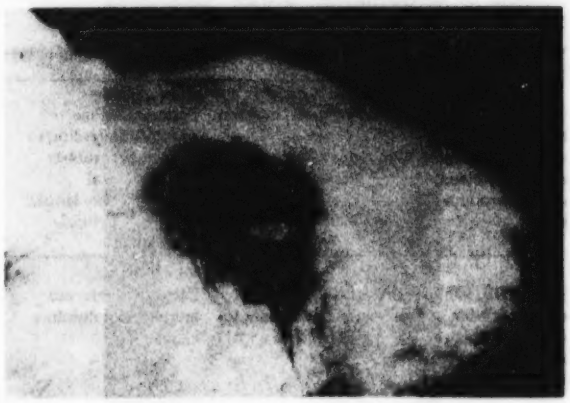


Figure 24. Conjunctivitis

* N. M. Patton, "Young Doe Syndrome", *Rabbit Research Newsletter*, Oregon State University, July 1979, Vol. 12, No. 3, p. 11.

Removing all fecal matter daily from the cage floor will help reduce bacteria, as will thorough ventilation.*

Other Diseases of Domestic Rabbits

Disease & Signs	Cause	Treatment & Control
EAR MANGE OR CANKER: Shaking of head, scratching of ears. Brown scaly crusts at base of inner ear.	Ear Mites - very contagious	Clean ear with an oil solution (e.g. mineral oil) twice weekly until all mites are eliminated. Isolate infected rabbits.
SKIN MANGE: Reddened scaly skin, intense itching and scratching with some loss of fur.	Fur Mites	Treatment by veterinarian may be required. Best to destroy animals and blow-torch cages.
RINGWORM: Circular denuded patches on face, feet and around anus.	Fungus - generally from other rodents.	Treat with suitable fungicide.
FUNGUS INFECTION: Scaly skin over shoulders or along back. Hair thin, dandruff.	Fungus	Apply commercial fungicide or 2% solution of Lysol to affected areas every other day for 1 week.
TAPEWORM CYSTS: Cannot usually be detected in live rabbits. Larval cysts in liver, intestines and stomach.	Larval stage of dog or cat tapeworm.	No treatment. Keep dogs & cats away from feed, water & nest box material. Eggs of tapeworm found in droppings of dogs & cats.
NEPHRITIS: Kidney disease. Marked loss of condition. Severe hair loss. Kidney lesions.	Various causes. Nosema parasite passed through urine or to unborn in uterus.	No treatment available.
URINE/HUTCH BURN: Inflammation of the external sex organs and anus. May bleed. Pus may be produced if severe.	Bacterial infection of the membrances.	Sanitation. Pay particular attention to areas where rabbits urinate. Local applications of lanolin may be beneficial.
METRITIS: White sticky discharge from female organs. Palpation indicates enlarged uterus.	Infection of uterus by variety of bacteria.	Dispose of infected animals and disinfect cages.
ORCHITIS: Infection or inflammation of the testicles.	Pus-forming bacteria.	Cull. Breeding bucks with orchitis may produce metritis in does and vice versa.
MASTITIS: (Blue Breast) Breasts feverish & pink later turning black & purplish. Temperature elevated; appetite poor; won't nurse young.	Bacterial (usually staphylococcal) infection of the breasts.	Intramuscular injections of penicillin. Do not transfer young to another doe.
CAKED BREAST: Breasts become firm & congested with hard knots at sides of nipples.	Milk not drawn from glands as fast as formed.	Do not wean young abruptly.
CONJUNCTIVITIS: (Weepy Eyes). Inflammation of eyelids with discharge causing fur around eye to become wet and matted.	Bacterial infection of eyelids. Also by airborn irritants.	Various eye ointments.
ABSCESSES AND BOILS: Lumps occurring under skin over ribs & back, neck, dewlap, mammary glands.	Various bacteria.	May break and drain naturally. Ask vet for treatment.
PNEUMONIA: Dullness; quick labored breathing with nose held high. Bluish color to eyes & ears. Lungs congested.	Bacterial infection of the lungs.	Penicillin effective if administered early.
SEPTICEMIA: Often sudden death before any symptoms. Extreme weakness, greatly elevated temperature, heavy breathing.	Pasteurella bacteria infecting bloodstream.	Antibiotics. However lack of clinical signs and short duration do not allow time for treatment.
PERITONITIS: Elevated temperature, reluctance to move; tense sore abdomen; fast, shallow breathing.	Pasteurella bacteria infecting membrane lining abdomen.	Antibiotics if diagnosed in time.

(NOTE: For a more detailed account of the above and other diseases of rabbits, refer to *Domestic Rabbits: Diseases and Parasites*, U.S. Department of Agriculture Handbook No. 490).

ABNORMALITIES

There are a number of conditions which are not, strictly speaking, diseases, but which are not to be tolerated in a well-run rabbitry as they directly affect productivity and profitability.

Yellow Fat

The tendency to yellow fat is inherited. The market does not accept yellow fat in rabbits, not because yellow fat is harmful but because it is unsightly. Yellow fat is more easily seen in adult rabbits. Rabbits with yellow fat lack the enzyme that breaks down xanthophyll, a pigment found in green feeds. Instead of being destroyed, the xanthophyll is deposited in the fatty tissues, which then become bright yellow.

Malocclusion (Wolf Teeth, Buck Teeth)

The teeth of the rabbit grow constantly but are kept from growing too long by the wearing action of chewing. When the teeth fail to meet at the proper angle, unusual growth will occur. Generally the upper incisors turn inward and the lower ones turn outward preventing normal chewing action.

Figure 25. Rabbit with malocclusion

Signs of malocclusion are gradual loss of appetite and weight. Both sides of the mouth may become stained with saliva. Because the rabbits are unable to chew properly, they become progressively listless, dehydrated and thin. Eventually death from starvation results.

Malocclusion of the incisors can be corrected temporarily by cutting back the teeth so that the rabbits can eat and attain good condition prior to slaughter. Malocclusion can be the result of injury or an abscess in the jaw area, but it is more likely to be an inherited trait that can be eliminated through selective breeding.

* N. M. Patton & P. R. Cheeke, "Etiology & Treatment of Young Doe Syndrome *Journal of Applied Rabbit Research*, (OSU 1980), Vol. 3, No. 3, p. 23.

Splay Leg

Splay leg in rabbits is due to a recessive gene and is characterized by limbs that are twisted so that the animal exhibits a double-jointed posture. The animals are not paralyzed nor unwell, but they should not be used for breeding.

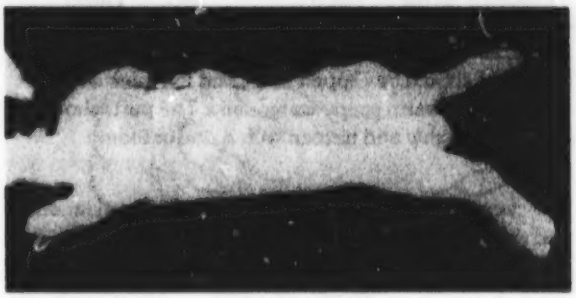


Figure 26. Rabbit with splay leg

Sore Hocks

Sore hocks are inflamed, infected, bruised, abscessed or raw bleeding spots found on the bottoms of the hind feet. The condition seems to be found more often in the larger breeds of rabbits and results from the rabbit having inadequate foot fur and padding to enable it to withstand life on wire mesh floors. In all cases of sore hocks the affected rabbit has thin fur padding on the hocks — an inherited tendency. Sore hocks may appear in nervous bucks that engage in constant foot stamping. The rawness of the hock is further aggravated by water and urine, high humidity, increased or excess body weight or injury.

Figure 27. A rabbit with sore hocks

A rabbit with sore hocks will lie down a great deal or move about very gingerly putting as much weight as possible on the front feet. Following this shift in weight, sores may develop on the pads and between the toes of the forefeet as well. Affected bucks and does will be reluctant to mate.
Severely affected rabbits should be culled. In milder cases, healing may occur if the rabbits are placed in a well-drained pen with an earth floor. The matted fur of the hocks should be clipped away and the infected areas washed with warm soapy water daily. The parts should be dried thoroughly and treated with a zinc or iodine ointment.

The cages of rabbits with sore hocks should be cleaned and disinfected and inspected for any rough spots on the wire floor.

Wry Neck

In young rabbits, wry neck can be caused by injury, but in adults the condition is usually brought about by inflammation of the inner ear (often by canker) affecting the rabbit's sense of balance. The rabbit loses its sense of balance and carries its head on one side with the eyes rolled up and backward. When the animal attempts to move, it rolls over. Because of the twisting of its head, the rabbit cannot eat and eventually will starve to death unless culled. There is no treatment for wry neck.

Figure 28. Rabbit with wry neck

Rabbits frightened by intruders to the rabbitry sometimes race frantically around and around their cages. Wry neck may appear among one or more of these rabbits within a day or two after injury sustained during the period of alarm.

Paralyzed Hindquarters

Frantic movements brought about by fear can result in injury to the rabbit's back in the form of broken back, displaced disc, or damage to the spinal cord and nerves. Pregnant does are often found dragging their hind legs and unable to stand or to support pelvic weight. The bladder will fill but not empty. The only recourse for the breeder is to kill the afflicted rabbit and to protect the herd from disturbing factors.

Glaucoma

Glaucoma will appear first as a light bluish cloudiness in the corner of one or both eyes of the rabbit. The eye becomes progressively opaque and protrusion of the eyeball becomes noticeable. Complications associated with glaucoma are reluctance to breed, poor appetite, a general loss of good health and eventual blindness. This defect is inherited and is transmitted as a recessive trait. Affected animals should be culled.

Fur Chewing

It is difficult to find the cause of young rabbits start to chewing each other's fur, eyelashes or feelers. Overcrowding or boredom may be one reason; shortage of fibre, of protein or of iodine may be another. Fur chewing may also be just a bad habit.

During the process of cleaning themselves by licking, rabbits will swallow some fur which will not be digested. It may collect in the stomach and form a fur block that interferes with digestion. If the handler notices that a rabbit is off its feed and that its droppings are linked together by fur fibres, fur block may be suspected. An extra ration of hay may be effective in moving the blockage. In more severe cases it is necessary to administer mineral oil by stomach tube to save a rabbit with fur block from dying of starvation.

XI: GENERAL HERD MANAGEMENT

Success in raising rabbits depends upon efficient management. The rabbit raiser must establish sound principles of breeding, handling, feeding, sanitation and disease control, culling and record keeping which together form the basis for a daily work routine. It is wise to establish a rabbitry policy in which visitors are discouraged, bucks are not loaned and the routine of the rabbitry is upset as little as possible.

HANDLING RABBITS

Becoming thoroughly acquainted with the characteristics, health and behaviour of rabbits through daily inspection is essential. Because rabbits are excitable, one must learn to work quietly among them. Rabbits can be frightened by loud, strange or sudden noises, prompting them to stampede around their cages and possibly injure themselves. They may also jump into the nest boxes and injure litters. A radio playing in the rabbitry may mask other noises and accustom the rabbits to a variety of sounds.

Rabbits must be lifted and handled by the producer in order to examine them for disease or injury or to move them. Rabbits must never be lifted by the ears or by the legs because such actions usually result in injury to the rabbit. Small rabbits may be lifted by grasping them around the loin. This method prevents bruising the carcass and damaging the pelt. A mature rabbit may be lifted by grasping the fold of skin over its shoulders with one hand and supporting its rump with the other hand. Tucking the rabbit's head under the handler's arm tends to calm the rabbit and keep it from struggling.

Rabbits can and will fight and scratch the handler. Rabbits' toenails can be clipped if they become too long. Exceptionally mean tempered rabbits should be culled from the herd.

(NOTE: All persons working with live rabbits should ask their doctors for tetanus shots, for a rabbit bite or scratch can cause this disease in humans.)

Rabbits that are used to being handled are easier to work with and are less subject to nervous stress than are those left untouched by the raiser for long periods of time. Rabbits can be trained. Training does to submit to palpation and forced mating, for example, is particularly worth while.

TATTOOING

Placing permanent ear numbers in one ear of each rabbit kept for replacement stock is an accepted practice in commercial rabbitries, for it is absolutely essential to

Figure 29. How to carry rabbits

accurately identify all rabbits used in the breeding program for record keeping.

Making a tattoo in an ear of the rabbit is the best way to mark the rabbit. Reading a tattoo number in an ear is likewise the fastest way to identify a rabbit. To produce a tattoo, ink or dye must be inserted under the skin. The area to be tattooed should be cleaned with rubbing alcohol. Then the tattoo clamp is applied firmly, followed by an application of ink which can be rubbed in with a soft toothbrush or cotton swab. A final glaze of petroleum jelly will protect the puncture marks from infection.

During tattooing the rabbit should be properly restrained so that it will not injure itself or the handler. Tattoo boxes may be used to restrain the rabbit. These are adjustable rectangular boxes that exactly fit the length, breadth and height of the rabbits, rendering it immobile. The rabbit's ears protrude through the top. However, if rabbits of various sizes are to be tattooed, even adjustable boxes will not be safe for all rabbits, particularly if such boxes allow even the slightest movement of the rabbit's head. A rabbit that has room to wiggle during the tattooing process can injure itself badly, even breaking its neck. Restraining the animal to be tattooed in a towel or a clean burlap bag is also effective and causes no harm to the rabbit.

DETERMINING SEX

A breeder must be able to determine the sex of young rabbits, particularly if a market for breeding stock or laboratory specimens is available or if replacement stock is to be selected. The sex of a rabbit may be determined three days after birth but the practice is not recommended owing to the risk of injury to the delicate organs. The sex of rabbits may easily be determined at the time of the 56-day weighing. (See section 11: Breeding Programs).

One method of determining sex is to hold the rabbit's head between the handler's thighs while supporting the

Figure 30A. Determining sex: doe

Figure 30B. Determining sex: buck

hindquarters. The forefinger of the free hand depresses the tail back from the anus and genitals, and the thumb depresses the area in front of the sex organs to expose the reddish mucous membrane. In the buck the penis will protrude as a rounded tip, while in the doe the membrane will protrude to form a slit with a depression at the end next to the anus.

CASTRATION

In producing domestic rabbit meat for market, there are no advantages to be derived from castrating bucks to improve the rate of growth. Some breeders claim they must castrate fryer bucks to keep them from fighting, but such animals should be marketed long before the age at which they begin to fight with each other. In a busy rabbitry, castration is a waste of time.

SANITATION AND DISEASE CONTROL

Good management, stringent sanitation measures and ruthless culling are all important in the control of disease in a rabbitry. The prevention of stress and disease is far more profitable than attempting cures. Ensuring proper procedures of sanitation is the most time consuming and the most laborious task in running a rabbitry. But the effort required to keep a rabbitry clean will lead to a trouble-free operation. To control disease it is important to adhere to the following guidelines:

1. Clean feeding utensils regularly (at least with each new litter) with a germicidal soap and water; rinse in clear water. Allowing the utensils to dry in the sun will sanitize them further.
2. Never put a new rabbit into a cage that has not been thoroughly disinfected. Doe cages should be disinfected following the weaning of each litter. A propane torch can be used to burn accumulations of hair - particularly in times of moult - from the wire

cages..The cages can then be scrubbed with a disinfectant.

3. Thoroughly disinfect the nest boxes following removal from the cages.
4. Burn soiled bedding.
5. Remove contaminated feed.
6. Dispose of manure as often as is necessary to keep ammonia levels down and to control flies.
7. Make sure the rabbitry is free from vermin, and be sure that it cannot be entered by stray animals.
8. Keep the rabbitry adequately ventilated, and avoid drafts and dampness. Maintain an even temperature.
9. Avoid overcrowding.
10. Keep down the numbers of new stock introduced to the rabbitry.
11. Provide separate isolation pens for rabbits that have been newly acquired or are returning from shows. Isolation time should be a minimum of 2 weeks. If the rabbits show evidence of disease, they should be destroyed.
12. Similarly isolate sick animals or those suspected of having disease to determine whether they are dangerous to the health of the herd.
13. Incinerate or deeply bury the carcasses of dead animals.
14. Always tend to the rabbits in isolation at the end of the daily routine, or have a separate attendant with separate tools look after the isolation unit. The rabbit handler is the greatest carrier of rabbit diseases.
15. Wash thoroughly after handling sick animals.
16. Do not lend bucks to other breeders.
17. Allow no visitors - especially from other rabbitries.

Disinfection must be a continuing process in the rabbitry, for whenever large numbers of animals are housed in a confined space, germs will pass back and forth from the animals into the environment, thus creating potential biological stress. Airborne germs are usually distributed unevenly in rabbitries with the highest concentration above cage height. This situation results from germs rising on warm air currents and settling on roof areas. The germs easily fall back onto the stock, creating a disease hazard.

In any sanitation program the degree of contamination must be ascertained by laboratory analysis of dust samples. A disinfection program can then be designed for three separate areas:

1. *Walls and floors* — use a biocide (such as used in dairies) that will penetrate concrete and wood.
2. *Equipment* — use an iodine detergent. If automatic waterers are used, the lines should be flushed regularly with chlorine bleach and then flushed with clear water.
3. *Areas above the cages* — use aerosol disinfectants. Aerosols can also be used for dispersing insects and controlling flies.

CONSULTING A VETERINARIAN

The rabbit raiser's decision to consult with a veterinarian about problems of disease within the rabbitry is often determined by the costs involved. If only one or two rabbits are sick and the problem is unlikely to spread, the rabbit raiser may decide against calling in a veterinarian, for the services of the medical expert may cost more than replacement stock for the diseased animals.

As rabbit raisers increase their knowledge and expertise, they become able to treat their own ailing livestock effectively, even to the extent of administering intramuscular doses of medication as may be prescribed by a veterinarian. Whether the breeder treats the disease problems or whether someone is hired to do it, valuable time is spent - and labor is expensive. A commercial breeder cannot afford to fuss with treating a lot of disease problems of animals that should or could be culled from the herd.

THE USE OF DRUGS

The indiscriminate use of drugs in treating entire herds may simply mask poor management techniques. Drugs and treatment are expensive in terms of time and money. Furthermore, indiscriminate use of antibiotics leads to the development of antibiotic-resistant strains of bacteria.

The commercial breeder administering drugs must be aware of the correct dosage, the concentration, the method of administration and the length of time a drug must be withheld prior to marketing the rabbits for human consumption.

SUBMISSIONS OF SPECIMENS FOR LABORATORY DIAGNOSIS

The best way to obtain an accurate diagnosis of a disease that strikes a rabbitry is to take the dead rabbits or two or three sick animals showing typical symptoms to a provincial veterinary laboratory. In Alberta, regional veterinary diagnostic laboratories are located in Airdrie, Edmonton, Fairview and Lethbridge. The diagnostic service provided by these laboratories is free of charge.

Dead animals to be submitted must be kept cool (but not frozen) until they can be delivered. Particular care should be taken in the summertime because it is impossible to

make a proper examination of putrid material. The carcass should be wrapped in newspaper, packed in ice if necessary and delivered promptly.

At the lab the breeder can supply any information the pathologist may require such as:

1. Size of the herd
2. Number of sick or dead animals
3. Age and sex of affected animals
4. Description of symptoms
5. Dates of first and subsequent losses
6. Incidence of infection (i.e. just one cage or throughout the entire rabbitry)
7. What treatment, if any, already given
8. Type and brand of feed used in the past six months
9. Type and condition of housing

While awaiting diagnosis the rabbit raiser should apply principles of good hygiene to reduce spreading the infection.

DAILY MANAGEMENT SCHEDULE

1. Breeding

As breeding and successful kindling generate the actual profit in any rabbitry, the breeding chores should have top priority on the daily job list. It is uneconomical to allow the breeding program to fall so much as one day behind schedule.

2. Palpation

It is likewise vital to ascertain the pregnancies of previously bred does. Does ready for palpation must be attended to on schedule (at 10 to 14 days) and if not pregnant, must be rebred immediately.

3. Nest Boxes

Nest boxes must be given to the does on the eighteenth day of their pregnancies. If the addition of a nest box to a cage is delayed and an early doe is forced to kindle on the wire, her young may be lost, and so will one full month of production by that doe.

4. Litter and nest box inspection

New litters in nest boxes can be expected and counted and fostering carried out where necessary.

5. Weighing

The weighing of 21-day old litters must be attended to on the ***exact day*** for the producer to maintain correct records of the milk production of the does. Similarly, fryers should be weighed at 56 days to determine the ratio of feed given to the weight gained.

6. Selecting replacement stock

Following the weighing of the 8-week old young, decisions can be made regarding saving young that show promise as breeding stock. This is the time to include the tasks of sexing and tattooing young rabbits and of separating intended replacement stock from stock to be marketed.

7. Feeding

Feeding chores come later in the work day. This procedure suits the rabbits, for they are most active at night. Some breeders feed hay to the rabbits first thing in the morning to keep them occupied. Feeding time is a good time to check for injuries, abnormalities and evidence of disease.

8. Treating illness

Treating ailing, injured or diseased animals follows feeding.

9. Cleaning and disinfecting

When rabbit care is completed, the rabbit raiser can attend to the chores of cleaning the barn, cages and utensils.

10. Record keeping

Maintaining up-to-date records must conclude each work day. At this time the breeder can double check the work list to ensure that all tasks have been completed. How and when the date is recorded will depend upon the size of the rabbitry and the system used to keep records. Rather than trusting to memory, the breeder will likely make notes of the tasks performed in the rabbitry as the work day progresses. (See section 14: Record Keeping) Good management is reflected in accurate up-to-date records.

BREEDING PROGRAMS

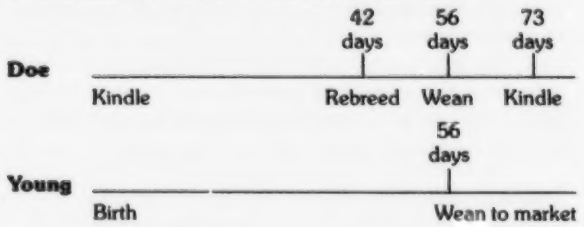
In commercial meat production herds, the goal is to maximize the number of saleable fryers. Thus, the most efficient production is attained by working the does to the full extent of their reproductive capacity. The commercial producer attempts to keep more than 75% of the working does bred or with litter and the conception rate* over 80%. The objective is to wean an average of 8 or more young per litter and to strive for specific weights at different ages.

It is generally agreed that litters should be uniform, with individuals weighing 340 g (12 oz) or more at 21 days and 1816 g (4 lb) or more at 56 days. The goal is to produce marketable fryers at 8 weeks of age, although in Alberta this goal has been achieved by only a very few rabbit producers.

* See XVII: GLOSSARY

Various breeding programs are used in the effort to maximize the numbers of fryers produced per doe. No one program can be considered "the best". Obviously what works for one raiser may not work for another. One's own capabilities must determine management practices that work best.

Five Litters per Year (42nd-day breed-back)



Advantages

Few extra cages required.

Fewer bucks needed.

Weaning the young directly to market avoids the extra stress of early separation of young from doe.

Feed conversion is lower for young due to reduced stress.

Does seem more ready to accept service of the buck when they still have young with them.

Schedule is easy to manage; a relaxed pace.

System is ideal for beginners and hobbyists.

Disadvantages

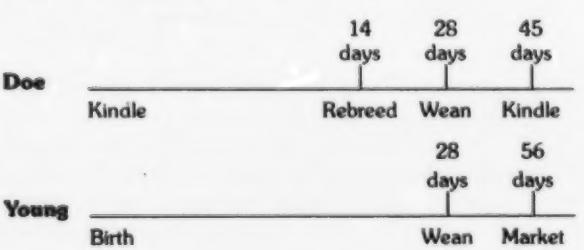
Fewer fryers are produced per doe per year.

There is the extra cost of feeding a doe that is not fully productive.

Does will get fat and lazy if not managed properly.

It is recommended that new raisers start with the five-litter per year program and stay with it until their herd is operating at a profit and until they have developed a good replacement program. Only then should a producer consider looking into the possibility of stepped-up breeding programs and whether or not the extra effort required would be profitable.

Eight Litters per Year (14th-day breed-back)



Advantages

The better does seem to thrive on increased demands.

Production is increased.

Inferior does can be culled.

Stock approaches a constant state of production.

Disadvantages

Requires additional holding cages or two cages per doe.

Higher feed conversion.

Supplemental feeding required - e.g. creep feeding.

More labor is involved in breeding, palpating and weaning.

Requires more replacements to be saved.

Risk of does being pulled down in condition.

More bucks are required.

Young face the nervous stress of early weaning.

Production life of the does is shortened.

Greater mortality - fewer young marketed per doe.

The fourteenth-day breed-back program is gaining popularity. Weaning the young at 28 days is logical because milk production of the doe declines abruptly during the fourth week, and the young are on a diet of predominantly solid food by this time so their requirements for milk are minimal.

Remating the doe at 14 to 21 days, depending upon her physical condition, and weaning the young at 28 days permits the doe to have two or three weeks alone while carrying the next litter. Her diet should be restricted (because lactation is no longer a demand) and her body allowed to devote its energy to the developing litter.

FURTHER CONSIDERATION

In the past, weaners were moved into large holding pens to fatten for market. However, it was discovered that in holding pens, the fryers increased their feed intake but gained weight at a slower rate. Several explanations for this increase in the feed conversion ratio are given. One is that putting two or more litters together creates stress and increases the competition for food. Another is that the increased space of the larger pens allows far more room for the rabbits to exercise, leading to an increase in the food consumed but with a greater wastage of feed energy.

Moving the litter from the cage in which they were born is also stressful. On a stepped-up breeding program it is more advisable to move the doe to a new cage rather

than to move the litter. The stress of separation may be reduced by using split cages (cages divided into two compartments) allowing the rebred doe to be separate from her weaned litter but still close to them.

Some producers are experimenting with post-partum remating (i.e. three to six day breed-back). In these programs the doe may be rebred almost immediately after she has kindled, making it theoretically possible for her to produce 10 litters per year. Depending upon the strain of rabbit used in the program, assorted problems (including high infant and doe mortality) have occurred. It would seem that the earlier the remating, the greater the stress on the doe and the greater the demands on management, sanitation and husbandry by the producer.

It is important to remember that breeding programs are really determined by the individual does. If a particular litter is small or can be reduced by fostering, and if the doe is in good condition, she can be rebred earlier than the chosen program dictates. To be economical a healthy doe should be kept in production; a nonproducing doe must still be caged and fed.

Unfortunately, does can and will stop production of their own accord. The fall barren periods are a frustration to producers trying to maintain a particular program of breeding. However, if the condition of a doe declines because of increased demands of pregnancy and lactation, she can cease production for as long as two to three months until she has rebuilt her body resources. Thus, the production capabilities of individual does will determine the selection of their progeny as replacement stock. It should be possible to develop a strain of rabbits that can handle a stepped-up breeding program.

The type of feeding program, the type of breeding program and the consequent management techniques used are dependent upon how much time a producer has, as well as realistic anticipation of a return on investment and labor.

XII: SELECTING REPLACEMENT STOCK

No matter how good the initial stock purchased when establishing a rabbitry, constant striving is necessary to improve the herd through culling and selection. Sometimes only 25% of the animals will actually be good producers, regardless of their good records and ancestry. Thus the rabbit raiser will be faced with the continuous challenge of upgrading the herd.

METHODS OF IMPROVEMENT

There are two methods of herd improvement. One method is for the rabbit raiser to purchase fresh superior stock from other raisers. The other method is for the raiser to selectively mate existing rabbits to produce superior offspring. In practice, both methods are often used together.

The method chosen depends upon the size of the breeding herd. With a small herd of 20 does, for example, there is limited scope (depending upon the number of strains initially purchased) for improvement through selection. The relative cost of running a selective breeding program should therefore be measured against the cost of buying fresh stock at regular intervals. It is difficult to maintain small numbers of breeding animals in closed breeding units owing to the risk of inbreeding depression (i.e. loss of vigor). Furthermore, beginners should not start a selection program too soon. They should first determine the characteristics of their existing stock in order to identify the characteristics to be improved.

New breeding stock should be selected which is superior to that which the producer already possess. It is often difficult to determine the genetic background of the rabbits; therefore, it is highly recommended that any new rabbits should be tested on a small scale before they are fully integrated into a breeding program.

One potential hazard of purchasing rabbits from other raisers is the incorporation of new diseases into the rabbitry. For safety's sake, all new stock should be isolated from the herd for a minimum of two weeks, in extra cages and separate housing. If the raiser decides to purchase replacement stock, rabbits should be bought as young as possible to save expense.

An advantage of raising one's own replacement stock is that the productive history and details of ancestry of the herd are more readily available. Each rabbit can be observed from birth. Another advantage is that the rabbits inherit a certain amount of disease resistance to the conditions of the home rabbitry.

A disadvantage of raising one's own replacement stock is that a good many extra cages are required to house the replacement stock in various stages of growth. In addition, more time, greater knowledge and more consideration of the situation are required on the part of the breeder.

It is not practical for a beginner to use the same standards and methods of selecting replacement stock as used by an established breeder. A beginner should determine what standards are attainable and select replacement stock which comes closest to those standards. As the quality of the herd improves, standards can be tightened. Replacement animals should be chosen for health and demonstrated vitality. They must not be judged alone but in relation to the entire litter. All litter-mates should be above the average before any of the members are singled out as possible replacement stock.

As a beginner, the producer may select young stock from those does and bucks which produce the most meat. As the herd improves and the individual's knowledge of rabbits increases, the more accurate method of herd improvement known as *progeny selection* can be introduced.

PROGENY TESTING

In progeny testing the breeder grades the best rabbits not only by their production levels but also on the records of their young. The characteristics of a high-production doe may not be genetically transmitted to her offspring. Thus, the progeny or young must be tested against the parents to determine which desirable qualities have been passed from one generation to the next. Thus the importance of maintaining records is stressed once more.

REPLACEMENT NUMBERS

In a large commercial venture, 35 to 40 does per year are required for replacements for every 100 producing does. Beginning operations may replace up to 50% of their does each year. The numbers depend a great deal upon the quality of the breeding stock used as well as the breeding program followed within the rabbitry. The stringency of the culling policy of the rabbit producer will also influence the demand for replacement stock. The raiser must keep more replacement animals than will actually be needed, because replacements may prove inadequate and may also contract disease and die. Furthermore, the producer has no dependable way of knowing how many replacements will be required at any one time in the future. One cannot wait until replacements are needed to save them, because such a policy takes cages out of production for several months.

The number of bucks required as replacement stock depends, of course, on the size of the herd and the frequency with which the bucks are used. Initially, services with a young buck should be restricted, gradually increasing until he is mating, on the average, seven does per week. Bucks will often maintain a satisfactory conception rate when serving two or even four does a day.

Both bucks and does should be replaced as soon as signs of productivity begin to fall off, as indicated by rabbit records.

SELECTING DOES

It is not wise to save young from a doe's first two litters; in fact, it is often wiser to wait until a doe has been in production one full season so that she can be seen to have fulfilled the following requirements:

1. The does must be easy to breed. The degree of receptivity is a characteristic that can be inherited.
2. The doe must conceive readily. A doe that misses is uneconomical.
3. The doe must kindle at least eight but no more than twelve per litter. Youngsters born in large litters are often smaller at birth and smaller at weaning age and have a higher mortality rate.
4. Litters must be uniform at birth. Lack of uniformity may indicate that both doe and litter are not in the peak of health.
5. The doe must be a good nurser. Weighing the young at three weeks will give an indication of the milk productivity of the doe.
6. The doe must wean no fewer than 7 young that will weigh at least 1.8 kg (4 lb) each at 8 weeks of age.
7. The doe must be healthy and be able to stay in top physical condition.

The average productive life of a doe is 12 to 15 litters. The number of years that she is used depends upon the breeding program followed. Large does do not always produce the best stock. Generally, however, the doe should have good body length and well-defined hindquarters with considerable depth to the loin, facilitating the production and feeding of large litters. A longer doe mated with a short blocky buck (which most producers seem to prefer) produces a meatier fryer. The treasured does are the ones which regularly produce large healthy fryers with meaty carcasses. Thus, the performance record may be much more important than the doe's appearance.

SELECTING HERD BUCKS

Though the litter itself usually depends more on the doe than on the buck, the *quality* of the litter depends 50% on the buck. While does are saved from approximately the top 10% of the herd, bucks should be selected from the top 2-3%, for the buck may father the offspring of as many as 20 does.

When selecting replacement bucks, choose those that:

1. Are ready breeders with few misses.
2. Sire large youngsters in uniform healthy litters.
3. Produce young free from defects and disease.
4. Produce fast-growing young with meaty carcasses.
5. Produce litters that have a higher than herd average weight at 56 days.
6. Are consistent in output.

The bucks themselves should daily convert feed into muscle and energy so that they are active and virile year round. The final selection from several candidates may be based on feed efficiency. By keeping a record of the individual weight gains versus feed consumption of the bucks from age 8 weeks to 16 weeks, the breeder can select the buck with the very best feed conversion ratio.

While the majority of the selection factors of both does and bucks are based on production statistics, the final criterion in selection should be the production of solid meaty carcasses.

XIII: GENETICS AND BREEDING SYSTEMS

The goal of every commercial rabbit raiser is to produce good litters of rabbits that are consistently profitable in terms of the amount of meat produced; that is, the cost of production should be less than the return from sales. Rabbits of poor quality or low productivity make rabbit raising unprofitable.

Because mating rabbits without giving thought to desired goals is unlikely to improve the herd, it is necessary to determine the goals and to plan matings accordingly. Therefore, the first step toward herd improvement is for the producer to determine the characteristics of the herd. The second step is to determine which characteristics need to be improved. A breeding program can then be planned in which the producer will choose the animals to become parents for the next generation and will decide upon the system of mating to be used. To do so with any degree of success, the producer must have some knowledge of the genetics of rabbits.

GENETICS

Genes are the units of heredity that are to be found within the chromosomes of every living cell. In the rabbit there are 22 pairs of chromosomes, or 44 chromosomes in total, in the nucleus of each cell. The sperm cells and egg cells contain one chromosome from each pair, or 22 chromosomes. In the process of fertilization the 22 chromosomes from the buck are paired with the 22 chromosomes from the doe, resulting in a new combination of 44 paired chromosomes in embryonic cells.

Separation of the chromosomes (and the genes they contain) occurs during the formation of the sperm and egg cells. The recombination of cells containing the chromosomes at fertilization is random, giving rise to a great variety of individuals. By selecting particular rabbits to be mated, the raiser attempts to improve the rabbit population by increasing the incidence of desirable traits. The aim of the process of selection is to improve the odds that genes which will improve productivity and quality will be combined at fertilization.

TRAITS

A trait is a distinguishing feature or characteristic of an individual in character, habit or appearance. There are two groups to consider.

1. Qualitative traits

Qualitative traits, often referred to as simply inherited, are controlled by one or only a few pairs of genes and are rarely affected by an individual's environment. Such traits have been described as being dominant or recessive. Traits expressed by dominant genes will appear even though other genes are present. Traits expressed by recessive genes are masked by the dominant genes and may not appear for generations, or until they are matched with similar recessive genes.

Eye color, fur color and buck teeth are traits that are each determined by one pair of genes. The following table illustrates the pattern of occurrence for buck teeth.

		Doe: T	Doe: t
Buck	T	TT	Tt
	t	Tt	tt

Offspring

T = dominant trait

t = recessive trait

Both the buck and doe have normal teeth but both carry the recessive gene (t) for buck teeth. Thus we see that 25% of the offspring will have buck teeth (tt) while 75% will have normal teeth. However, two out of every three of those with normal teeth carry the gene for buck teeth which they will pass on to successive generations.

If one parent has no recessive gene for buck teeth but the other parent does, all of the offspring will appear normal, but half will still be carrying the recessive gene for buck teeth:

		Doe: T	Doe: t
Buck	T	TT	Tt
	T	TT	Tt

Thus a pair of rabbits that complement each other can produce quality fryers but inferior breeding stock, for in subsequent generations the recessive traits may keep reappearing.

2. Quantitative traits

Quantitative traits are governed by many gene pairs, and their expression may be more strongly influenced by environment. For instance, a rabbit's genetic potential for fast or slow growth is determined at conception, but the conditions under which it is fed and managed determine whether or not it will perform according to its genetic potential. Heritability is used as a measure of the relative influence of heredity and environment on a trait. The following quantitative traits are listed in the approximate order of most heritable to least heritable. (Those traits with the highest heritability will be improved more rapidly).

a. Carcass dress-out weight
b. Market weight
c. Milking ability
d. Feed efficiency
e. Average daily gain
f. Disease resistance
g. Longevity
h. Litter size

Rabbits chosen as parents in a system of breeding should be those exhibiting traits of high heritability and economic value.

BREEDING SYSTEMS

Once the individuals for breeding are chosen, a system of matings must be established. There are several systems to choose from.

1. *Random mating*

Random mating is the mating of the chosen individuals at random; that is, no consideration is given to the genetic relationship of the individuals being mated. Random mating itself neither improves nor decreases the performance of the offspring.

2. *Inbreeding and linebreeding*

a. Inbreeding

Inbreeding is the mating of closely related individuals; that is, breeding brother to sister, father to offspring. There are two major arguments for inbreeding: (a) purification of the inbred line for defect, (b) hybrid vigor when crossing two inbred lines. It must first be established that there are no outstanding weaknesses in the participating family, because such close breeding intensifies every family characteristic. Therefore, if there is a tendency toward low milk production, for example, this characteristic will be intensified in the offspring.

Through the process of inbreeding, genetic variation in individuals is reduced. Because both dominant and recessive genes become fixed, inbreeding is a most effective way to screen out carriers of detrimental recessive genes. With this system, very strict culling must be employed to eliminate undesirable traits. However, if inbreeding is carried on for too many generations, the vigor of the line will be diminished.

b. Linebreeding

Linebreeding is the mating of less closely related individuals in an attempt to preserve or increase the genetic influence of a common ancestor. A buck may be bred to his half-sister or his grandmother. By such means, the characteristics of the line can be intensified, but there is less chance of intensifying some obscure undesirable trait.

Linebreeding is most valuable when the common ancestor is deceased, for its genes can be concentrated through the matings of its relatives. It is imperative that the common ancestor be documented as a superior specimen. Most commercial breeders prefer linebreeding over inbreeding because there is less depression of vigor and reproductive performance.

3. *Outcrossing and crossbreeding*

a. Outcrossing

Outcrossing is the mating of unrelated individuals within the same breed. Although the matings of such individuals will normally be expected to result in improved performance, it will still be necessary for the producer to select matings carefully to achieve maximum potential. To implement outcrossing, the producer would need to maintain two or more populations. Such populations could be maintained by random mating.

b. Crossbreeding

Crossbreeding is the mating of individuals of differing breeds. Such matings greatly increase the likelihood of obtaining hybrid vigor, especially for reproductive fitness traits. Because the individuals being mated are more genetically diverse than in outcrossing, the likelihood of hybrid vigor is increased. The first generation hybrids are very valuable to the commercial producer because the young grow at a faster rate with better feed efficiency than if two purebreds were mated.

To get the best economic results from hybrid superiority, the guiding rule is that the best purebreds will produce the best hybrids. Indiscriminate matings of unproven breed members can generate poor quality offspring.

It is possible through selective breeding, progeny testing and stringent culling to bring out the best in the rabbit herd. The breeder may choose to maintain several lines of unrelated animals within the herd for possible crossing between the lines for increased meat production. Whatever systems are used, the most important aspect to ensure success is a sound system of record keeping.

XIV: RECORD KEEPING

In any business, record keeping is important; in rabbit raising it is absolutely essential. Because record keeping takes time, only records that are useful to the producer should be kept. They should be as simple as possible and as complete as necessary. The scale of the recording system adopted will depend in large part on the breeding program followed. The information obtained from the records will be used for breeding purposes and to judge the profitability of the rabbit raising enterprise.

Records important to all rabbit raisers will be those for pedigree of breeding stock, doe performance (milk production), buck performance, fryer production (including feed conversion ratios) and profit or loss. Keeping up-to-date records will also enable the rabbit raiser to plan the daily work schedule.

In setting up a records system, two considerations should be kept in mind: the initial entry should be made in such a manner that the desired summaries can be made with a minimum of effort; frequent transfer of data from one record form to another should be avoided to save time and decrease the chance of error.

THE DOE CARD

One of the most important records is the doe card. This record should include the individual doe, sire and dam numbers (or names), date of mating, the 21-day litter weight, date and number weaned and the weaned weight of the litter. The doe card is meant to be kept on the doe's cage, and if the doe is moved to a new cage, her card goes with her. Such a record will indicate whether the doe conceives regularly throughout the year, how many young she raises and her milk production. The latter ability is determined by the 21-day weight of the litter.

THE BUCK CARD

The buck card is a summary of the buck's performance and it is attached to his cage. As well as information regarding his identification, age and ancestry, details are recorded of each service he gives and the results of the service: the number born alive and dead and the date, plus the 56-day weight of the litter and the number weaned.

THE DAILY WORK CARD

Doe and buck cards are usually attached to the feeders of the cages for convenience in adding information. Though the cards carry essential information, the breeder must still search through the entire rabbitry for does to be bred or palpated or given nest boxes or weaned. In a large rabbitry, keeping all the duties sorted out and completed on time is a major concern. A system has been developed whereby a breeder can read at a glance the duties required on any given day in the rabbitry: "The 31-Day Pocket File".

All does bred on one day are entered on a daily work card (such as the one below). If, for example, three does are bred on the first day of the cycle, the doe number, cage number and buck number are recorded on the card along with the date of breeding. The card is then placed in the eleventh pocket of a 31-Day Pocket File. The eleventh pocket corresponds with day 11 of the cycle.

NAME OR EAR NO. _____ BORN _____ CAGE NO. _____

SIRE _____ DAM _____

SERVED BY	DATE	TESTED	KINDLED	NUMBER OF YOUNG					LBS. SAVED		21-DAY WEIGHT	REMARKS
				BORN	LEFT	ADDED	RAISED	DIED	BUCKS	DOES		

SP 1340F Printed in U.S.A.

Figure 31. Sample doe card

Hutch No. ..... Name or No. .....

Breed ..... Sire .....

Date born ..... Dam .....

Doe Serviced	Date Bred	RESULTS OF BREEDING			56 Days	
		Kindled		Date		
		Alive	Dead		Number	Weight

Figure 32. Sample buck card

On the eleventh day of the cycle, when the daily work card is read, the producer can see which three does are to be palpated. After palpation is completed, the date is written on the card and the card is returned to the file under day 29, the day that the does must be given nest boxes. Any does found not to be pregnant are re-bred and a new card written up for them and placed in the slot ten days hence. On the day 19, the first card is removed from slot 29, and the producer puts nest boxes into the appropriate cages and moves the card up to slot 31. On the day 31 of the cycle the same card will indicate which does are due to kindle on that day. When they kindle, the re-breed date is written on the card and it is returned to the file for that date. And so the process continues until the young are weaned.

The daily work card and a 31-day rotational filing system can be used in rabbitries of all sizes and can be adapted to any breeding program. The system is simple and foolproof if the cards are kept up to date.

DAILY WORK CARD Date Bred Oct. 1 Date Palpate Oct. 11 -day Rebreed (NEW CARD)

Date Nest Box _____ Date Kindle _____ Date 5-day litter check _____ Date 21-day litter Wt _____

Date -day Rebreed _____ (NEW CARD) Date 56-day Ltr. Wt. _____

(1) Doe No.	Cage No.	Buck No.	(2) Pregnant Yes	(2) Pregnant No	(3) Nest Bx	(4) Kindle Live	(5) Kindle Dead	(6) Trans	(7) Dead 1-5 Days	(8) 21 Day Wt	(9) Day Re-breed	(10) 56 Day Wt.	Remarks
25	8A	5											
22	8C	4											
27	10B	1											

Figure 33. Sample daily work card

FEED CONVERSION RATIO

In determining the profitability of the rabbitry, the rabbit raiser must keep a constant eye on the ratio between the amount of food the rabbits consume compared with the number of kilograms of rabbit they produce: the feed conversion ratio. One method of calculating the FCR is to record the amount of feed given daily to a doe from the day she is bred to the day the young from that breeding are weaned. The feed card remains with the young to record the amount of food they consume until they are slaughtered. To the figures on the card is added the appropriate fraction (obtained from the ratio of bucks to does in the rabbitry) of the buck's ration during the total time for which the figures are being recorded. The total amount of feed consumed is then calculated and divided by the total weight of the litter at the time of slaughter. The resulting figure, for example 3.5, tells the producer that 3.5 kilograms (or pounds) of feed were required to produce 1 kilogram (or pound) of rabbit. The FCR is 3.5: 1. The aim of all producers of rabbit meat is to keep the ratio as low as possible.

The FCR obtained in the above manner does not, however, give the FCR for the total rabbitry. The true ratio is obtained by dividing the total amount of feed consumed over a set period of time (e.g. one month) by the total weight of the rabbits marketed during that time. The resulting figure takes into account the feed consumed by replacement stock and animals which die or are culled, and the feed lost by spillage or poor management.

HERD PRODUCTION SUMMARIES

Some composite records must be kept to help the raiser assess the performance of the entire herd as well as to evaluate the production of fryers. Such records usually take the form of herd production summaries that indicate the state of the herd on a regular basis (usually monthly), much the same as a monthly balance sheet does in a system of financial accounting. The following is a sample of such a summary. A monthly feed conversion ratio or the number of kilograms marketed may also be added according to the requirements and interest of the producer.

Herd Production Summary

For the month of _____ 19___

A. SUMMARY OF PRODUCTION

1. Number of breedings _____
2. Number of conceptions _____
3. Number of misses (subtract #2 from #1) _____
4. Percentage of conceptions (divide #2 by #1 × 100) _____

B. SUMMARY OF GESTATION AND KINDLING

5. Number of does kindling _____
6. Number of does dying prior to kindling _____
7. Number of does sold prior to kindling _____
8. Number of litters dead within the first 3 days _____
9. Number of litters transferred in first 3 days _____
10. Number of does left with a litter (subtract sum of #7 + #8 from #1) _____

C. SUMMARY OF GROWING PERIOD

11. Number of litters destroyed _____
12. Number of litters transferred during growing period _____
13. Number of does that raised a litter (subtract sum of #10 + #11 from #9) _____

D. SUMMARY OF YOUNG PRODUCED

14. Total young kindled and left with doe to raise _____
15. Total young weaned _____
16. Percent weaned (Divide #14 by #13 × 100) _____
17. Average number in litter raised per doe _____
18. Total weight weaned _____
19. Average weaned weight of the young (Divide #17 by #16) _____

E. SUMMARY OF MORTALITY

20. Number of young died in 24 hr___ 48 hr___ 1 wk___ 1 mo___
21. Number of does died _____, number of bucks died _____
22. Number of growers and replacement stock died _____

Total of deaths _____

FINANCIAL RECORDS

As in all businesses, financial records must be kept. The final judgment of the success of the rabbitry is whether or not it is operating at a profit.

PEDIGREE BOOK

If a producer is raising rabbits for sale as breeding stock or is developing a breeding system for producing replacement stock, some records of ancestry must be kept indicating the identity of the sire, dam and grandparents. Some notation as to the characteristics and production records of each animal in the breeding program will be a worth-while addition. Though simple pedigree cards such as the one below are available from feed companies, notebooks with simple comments regarding litter size, mothering ability, etc. will be valuable.

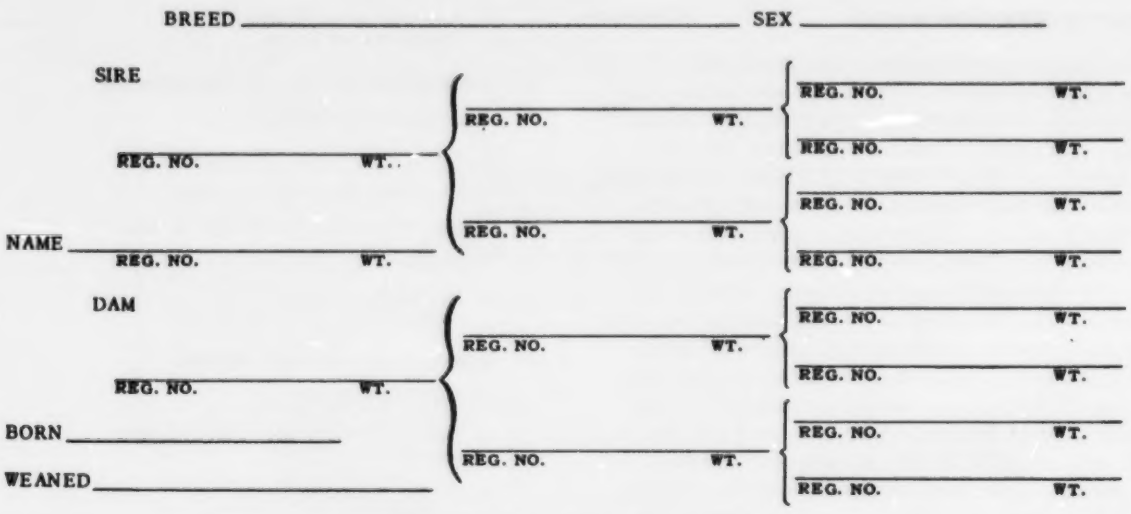


Figure 34. Sample pedigree card

USING HOME COMPUTERS

The drop in price of microprocessors and their increased availability in recent years has made the idea of a computer in the large rabbitry an economic possibility. Because running a rabbitry is a labor intensive enterprise, computers are ideally suited to keeping all the records the producer may require. A computer program can be designed to store all herd information, provide a daily work sheet, record breeder and litter performance, run a genetic program for selecting or culling stock, provide monthly summary sheets, calculate feed conversion ratios, keep track of the monetary transactions and even evaluate the maternal ability of the does. The larger the rabbitry, the more beneficial a microcomputer would be to reduce the costs of labor and human error.

XV: ECONOMICS

CAPITAL COSTS

When discussing the economics of rabbit raising, one must realize that two different types of costs are involved: capital costs which, for purposes of discussion in this chapter, involve the actual costs of building a new rabbitry from the ground up; and operational costs, which are regular costs one encounters when operating a rabbitry.

In Alberta year-round rabbit production involves the provision of adequate housing. Minimum housing and ventilation costs allowing 1.58 m² (17 ft²) per cage, single tier including walkways and end space, with no facilities for office, feed storage or isolation areas, is $160 per m² ($15 ft²)*. The basic cost depends on the amount of excavation work required, the amount of cement used and whether or not a building contractor is hired.

Caging costs can vary from $13 (homemade) to $23 (purchased) per cage. Basic cage equipment (feeders, waterers, nest boxes) is an additional $11 per cage. Costs of breeding stock vary from $8 to $10 for young rabbits to $20 to $30 for mature animals. Age and quality are the significant variables here. Additional capital costs will include the extra equipment required such as feed bins and cleaning equipment. A vehicle for transporting feed and rabbits is also essential.

In any assessment of the cost of a new project there are a great number of variables, thus making the determination of an exact figure impossible. The initial expenditure will be reduced if an existing building can be modified to accommodate rabbits. The cost of cages and nest boxes is reduced if they are constructed by the rabbit raiser, but the quality of the equipment must not be reduced in an effort by the rabbit producer to save money. Capital investment must be balanced with recurrent expenditures and labor requirements for effective operation.

It is often necessary to trim the ideal rabbitry to fit the individual circumstances, but there is a point beyond which adaptation and makeshift procedures become uneconomic and unsuitable.

OPERATIONAL COSTS

To discuss variable or operational costs one must start with some basic assumptions. It is accepted that each doe must cover all costs through the sale of her offspring and ultimately herself. From this income must be subtracted the feed that all the rabbits consume. The remaining money must then cover all other expenses. The illustrations used in this chapter are determined from costs in 1981 and are based on the following conditions:

1. Costs are calculated per productive cage (i.e. cage with doe in production) rather than per doe, because of culling and mortality, few does produce at maximum for a full year.
2. Costs are calculated on an average of five litters per production cage per year. Theoretically, rabbits can produce a litter every 31 days. In reality, however, nature provides rest periods through frequent misses and small litter size. Regardless of the breed-back system, a maximum of 5 litters per productive cage is a realistic estimation of yearly production, again because of mortality, culling and conception rates.
3. The average size of the marketable litter is six young. Does can and will produce 10 to 12 young per litter, but because of nest box mortality and the need to save replacement stock, plus the management practice of fostering small litters, the actual rate is closer to six marketable fryers per litter.
4. In the long run, single-tiered caging is most profitable. Tiered caging permits two or even three cages over the same 1.58 m² (17 ft²) of floor space. Thus multiple tiers make for a definite saving in the cost of the building per cage, but they create additional expenditures for dropping pans as well as increased labor costs. The single-tier system lends itself to ease of management and improved husbandry as well as more accurate controls in ventilation and humidity, all of which ultimately lead to higher production levels.
5. Sales of breeding stock amount to approximately 5% of fryer sales per year.

Operational costs include feed, labor, depreciation, interest, insurance, and miscellaneous expenses such as utilities:

A. Feed

The largest operational cost of a rabbitry is feed. The actual cost to the producer depends upon whether feed is purchased by the bag or in bulk or is produced by the grower, entirely or in part. Feed costs in 1981 averaged $0.29 per kilogram ($0.13 per lb) for 18% commercial pellets and $0.24 per kg ($0.11 per lb) for 15% commercial pellets. Feed control and the subsequent reduction of the feed conversion ratio are determined in large measure by careful management.

The following is a calculation of yearly feed costs per production cage:

5 litters × 54.5 kg (120 lb) feed/litter @ 28.6¢/kg (13¢/lb)

= $78.00, plus

proportionate share of bucks and all other stock:

* 1981 Canadian dollars

33.18 kg (73.0 lb) feed @ 24¢/kg (11¢/lb)

= $12.00 for a herd total of **$86.00**

B. Labor

Although labour is not considered a monetary cost to every raiser, it is a time cost and as such can be calculated.

Estimated Minimum Time Required per Production Cage

Operation	Minutes per Year
Feeding	365
Breeding	30
Palpating	12
Cleaning & Installing Nest Box	30
Nest Box Checks	18
Litter Weight & Sales	60
Manure Disposal	30
Extra Care: Burning off hair	45-55
Disinfecting cages	
Repairing water line	
Record keeping	
Building maintenance	
Treating diseases	
	590-600

The total labour required per production cage per year is approximately 10 hours.

C. Depreciation

The building and equipment will wear out over time and must eventually be replaced. Therefore, depreciation in the value of these items should be incorporated as a cost over time.

D. Interest

Whether obtaining financing to construct a rabbitry or whether using available capital, the rabbit producer must consider the interest paid or lost on that money as an operational cost.

E. Insurance

Insurance is mandatory with a mortgage. For all rabbitries regardless of size, insurance (usually 1% of total value) is well worth the expense.

F. Miscellaneous expenses

Taxes

Gasoline and vehicle costs

Medicine and veterinarian costs

Utilities

Repairs to building and equipment

Miscellaneous expenses have been estimated to be about $0.20 per kg ($0.09 per lb) of rabbit marketed.

INCOME

Example A

Fryer production per production cage:

5 litters × 6 young × 2 kg each (4.4 lb) = 60 kg (132 lb) × $1.65 (75¢) = $ 99.00

Sale of breeding stock: 5% × $99.00 = 4.95

Sale of culls: 4 kg (8.8 lb) × $1.00 (45¢) = $4.00 × 50% replacement = 2.00

$105.95

Example B:

Fryer production per production cage:

5 litters × 6.5 young × 2 kg (4.4 lb) = 65 kg (143 lb) × $1.65 (75¢) = $107.25

Sale of breeding stock: 5% × $107.25 = 5.36

Culls: 4 kg (8.8 lb) × $1.00 (45¢) = $4.00 × 50% replacement = 2.00

$114.61

The increased income in Example B over Example A illustrates the increase in production which can be brought about by improved management. Example A assumes an average of 6 young marketed per litter. Example B assumes an increase in fryer production of 0.5 rabbits per litter. If at the same time the feed conversion ratio is decreased just enough to accommodate the extra 0.5 young (i.e. food consumption remains the same), the income per year per production cage after the deduction of feed costs is as follows:

Example A: $105.95 (income) - $86.00 (feed) = $19.95

Example B: $114.61 (income) - $86.00 (feed) = $28.61

Sample Economic Data Sheet

Assumptions:

- original start - new rabbitry
- family operation
- 100 working does
- 5 litters/year/production cage
- 6 fryers marketed per production cage
- 10 buck cages
- 45 fattening cages
- 20 replacement stock cages

- 5 saleable stock cages
- single tier

Capital Costs

Housing - with heating and ventilation		
33.55 m × 8.54 m = 286.52 m² @ $160		
(110 ft × 28 ft = 3080 ft² @ $15)		$46 200.00
Equipment		
180 feeders @ $4.00	$ 720	
180 cages @ $13.00	2 340	
50 nest boxes @ $3.95	198	
Watering equipment		
180 @ $4.00	720	
Miscellaneous	500	
	$ 4 478	4 478.00
Rabbit inventory		
100 does @ $18 (average)	$ 1 800	
10 bucks @ $18	180	
	$ 1 980	1 980.00
TOTAL CAPITAL COSTS:		$52 658.00

Variable and Other Costs (per year)

Feed		
100 production cages × $86	$ 8 600	
Depreciation		
Buildings - $46 200 @ 5%	2 310	
Equipment - 4 478 @ 10%	448	
Interest - average annual		
9% on total capital costs	4 739	
Insurance		
1% of capital costs	527	
Miscellaneous	1 188	
	$17 812	
TOTAL VARIABLE COSTS:		$17 812.00

***Income**

100 production cages × $105.95 = $10 595

The 100 production cages in the rabbitry described above will generate an annual income of $1 995 *over feed costs*. ($10 595 - $8 600).

On the basis of these figures it would seem that raising rabbits will not pay all the variable costs, let alone cover large capital costs.

Multiple tiering is not a solution to the problem of low income, for multiple tiering increases the cost of equipment but does not increase the income per production cage. Multiple tiering will, however, decrease the building cost per production cage and should increase the income from the building if managed properly.

The foregoing estimation of possible costs and income given here is to serve as a guide and includes every conceivable expense. The specific figures quoted will not apply to every rabbit raising operation and indeed may be somewhat severe. However, it is not the aim of this publication to discourage people from raising rabbits but to make them aware of the possible expenses to expect.

One is advised to calculate one's own costs on the basis of one's own situation. For instance, depreciation figures may be decreased, interest need not apply, utilities may vary. Converting an existing building into a rabbitry may lessen considerably some initial capital costs.

A recent study** prepared by Alberta Agriculture presents a slightly different approach to the calculation of income but with conclusions similar to those reached above.

The rabbit industry in Alberta is currently showing a poor financial return. Those persons claiming that sizeable profits are to be realized from raising rabbits have given figures based on inadequate research and unrealistic, frequently over-promoted economic projections. A realistic economic analysis would indicate that rabbit producers should expect a negative cash flow from the start-up of production for about three years. It is also not feasible to buy outright mature breeding stock in large numbers because such quantities of good breeding stock are not available from within the province.

It is apparent that on a large commercial basis, rabbit raising is not yet a profitable venture. Until the rabbit industry can achieve a goal of 8 litters per year with 8 fryers marketed consistently from each litter, the rabbit industry will remain in the hands of the small producer using existing buildings and family labor. Success in the rabbit industry is highly dependent upon skillful management and constant production.

* See Example A p. 52.

** G.E. Patsula, *Economics of Rabbit Production*, Alberta Agriculture, April 1982, p. 6.

XVI: PROBLEMS OF EXPANSION

Although the market for rabbit meat in Alberta is increasing steadily, persons wanting to become raisers of commercial meat rabbits are repeatedly cautioned to "start small". The meat rabbit industry is still in its early stages, and eager would-be rabbit raisers are advised to practise raising rabbits for a year or two before venturing into larger operations. Any producer who cannot raise rabbits successfully on a small scale, will surely be unsuccessful on a large scale. To date in Alberta, a truly commercial rabbitry - one that earns a profit of sufficient size to support its owner - does not yet exist.

Even if a rabbit raiser has had success managing a small herd and wishes to increase that herd, there are a number of factors which should be considered before expansion:

1. The capacity of the market to support an increase in the supply of rabbits must be determined. This may be done by communicating with a processor and by actively supporting rabbits as a meat source and working through an association of commercial rabbit producers.

2. Expanding a rabbit operation increases the demands on all aspects of management, from labor to record keeping. The chores of cleaning, disinfecting and sanitizing the rabbitry increase dramatically to the point where mechanical aids (such as augers to remove manure) become essential.

3. Automated watering and feeding must be introduced at some point in the expansion process to reduce the many hours of manual labor that would otherwise be required to complete these daily tasks.

4. Expanding the herd generally means expanding the housing facilities. It would seem that the larger the herd, the better the building must be in both design and construction. Financial investment increases accordingly. To raise several hundred breeding does, multi-tiered cages may be required to reduce the housing costs per doe. Such caging in turn makes greater demands on management.

5. As a rabbitry is enlarged and costs rise, the marketing of fryers becomes increasingly important to provide cash flow to balance fixed costs. Thus, a faster breed-back system must be used, again adding to the demands of management and in turn, increasing stress on the herd. Furthermore, the stepped-up breeding program will require still more cages for production as well as cages for replacement stock. Carrying extra replacement stock increases the feed conversion ration for the entire rabbitry.

6. Isolation wards must also be expanded. In most commercial rabbitries, isolation wards are buildings entirely separate from the main rabbitry.

7. As a rabbitry increases in size, replacement stock must be constantly upgraded. Mediocre animals will not support the business; only exceptional breeding stock should be used. Most producers, in an effort to expand their rabbitries quickly, save too many inferior does, thereby lessening productivity. Only half the average litter are does, and of these, only one or two may be exceptional enough to save for the future. These juniors must be kept for approximately six months before their performance can be rated.

8. A negative cash flow is generally experienced during times of herd expansion and may last for two or three years. One of the reasons is that rabbits being saved for replacement are not being sold. Expansion must be carefully planned in order to balance increased expenses such as building costs with regular bills and temporarily reduced income.

9. Disease control becomes much more difficult when rabbits by the hundreds are housed in one facility.

10. Record keeping in a large rabbitry can become a full-time job. It is readily apparent that a large commercial operation (e.g. 200 does or more) would today require the aid of a computer.

At the present time the rabbit industry in Alberta consists of many raisers of small herds rather than one or two large commercial operations. The current production methods are for the most part uneconomic and too labor intensive to suit the time and interest of the average grower. Equipment, facilities and management practices used today are not suited to intensive production and they yield a product of uneven quality and unreliable delivery. The rabbit industry will not become competitive with other livestock industries until these methods are improved.

According to a recent study undertaken at Colorado State University*, the primary factors contributing to the low profit margins are:

1. Seasonal breeding behavior.
2. Respiratory diseases.
3. Inadequate sanitation and mortality prevention programs.
4. High nest box mortality.

* H. L. Enos, D. D. Caveny, *et al*, "Equipment Management Options to Facilitate Year-Round Rabbit Production", OSU Rabbit Research Center *Newsletter*, Vo. 2, No. 4, p. 10.

5. Unsound economic practices and inadequate investment in the rabbitry. Still there are those dedicated scientists and rabbit raisers the world over who firmly believe in the future of the domestic rabbit and who are striving constantly to make improvements in all aspects of the commercial rabbit industry. They are also willing to help the novice develop a financially viable operation.

There are many in Alberta today who raise rabbits for the joy of it; there are others who raise rabbits because of the challenge they present to management. Whatever the reasons, rabbit raising can be rewarding.

XVIII: GLOSSARY OF RABBIT TERMS

Adult - a rabbit over six months of age

Abscess - a localized collection of pus in the body; a boil

Anorexia - absence of appetite or desire to eat

Back - the entire top portion of the rabbit extending from the neck to tail; the area covered by the backbone

Belly - the lower part of the body containing the intestine; the abdomen

Breed - a race or special class of animal which reproduce distinctive characteristics such as fur markings, etc.

Buck - a male rabbit

Caked udder - inflamed and feverish condition of the teats in a doe arising from a superabundance of milk

Cannibalism - doe eating her own young

Carcass yield - dressing percentage obtained by dividing the weight of the dressed carcass by the weight of the live rabbit × 100

Chest - the front portion of the body between the forelegs and neck

Chromosomes - rod-like structures containing the genes and occurring in pairs in the nucleus of a cell

Colony breeding - running one buck together with several does in a group at one time

Colostrum - the first milk produced by a doe after she gives birth

Conception rate - a percentage obtained by dividing the number of litters born by the number of matings X 100

Condition - the physical state of being of a rabbit revealed by health, firmness of flesh, brightness of eye, etc.

Confined mating - putting a doe in with a buck for several hours

Coprophagy - the consuming by the rabbit of soft night feces directly from the anus; pseudorumination

Crossbreeding - mating rabbits of two entirely different breeds or varieties

Cull - select and dispose

Dam - the female parent

Dewlap - a pendulous fold of loose skin hanging from the throat

Doe - a female rabbit

Dominant - referring to the genes or characteristics of one parent that when transmitted to the offspring cover up a subordinate or recessive characteristic

Dress-out - see carcass yield

Estrus - a recurring period in a female when she is more apt to conceive; a period of sexual heat

Fines - dust from pelletized food

Feed efficiency - the amount of feed required for a rabbit to gain one pound of weight

Flank - the sides of the rabbit between the ribs and the hips, above the belly

Follicles - sacs in which the egg cells are produced in female rabbits

Foot - the final part of the legs, including the toes, on which the rabbit stands

Forced mating - restraining the doe so that she may be mounted for mating by the buck

Fostering - giving the young of one doe to another to be raised

Full-feeding - making feed available to rabbits at all times so that they may feed at will

Fryers - tender young rabbits under twelve weeks of age and weighing between 1.8 kg (4 lb) and 2.75 kg (6 lb)

Genes - units of heredity in a chromosome, controlling the particular inherited characteristics of an individual

Gene pool - the number and variety of genes within a breeding herd

Genetic relationship - the number or percentage of genes that an individual has in common with its relative(s)

Gestation - period of time from mating of the doe to kindling

Heredity - property by which the offspring have nature and characteristics of parents or ancestors; genetic constitution of an individual

Heritability - that which may be inherited

Hip - the thigh joint and large muscular first joint of hind leg

Hock - the middle joint or section of the hind leg between the foot and hip

Hybrid - offspring of two rabbits of different breeds or varieties

Hybrid Vigor (Heterosis) - tendency of crossbred rabbit to show qualities superior to those of both parents

Inbreeding - the mating of closely related animals

Inbreeding depression - diminished vigor

Induced Ovulation - the releasing of egg cells in the doe being triggered by sexual stimulation

Junior - a rabbit less than six months of age

Kindle - to give birth

Knee - the second joint of the leg, connecting the thigh and the leg

Lactation - the secretion and yielding of milk by the doe

Litter - a number of young being raised by one doe

Linebreeding - the breeding of distantly related individuals within the same strain

Loin - that portion of the back on either side of the spine, between the hips and the ribs

Malocclusion (buck teeth or wolf teeth) - a deviation from the proper closing or meeting of the teeth

Meaty - the quality of being able to carry a goodly proportion of meat in proportion to the size and type of rabbit - particularly noticeable in forequarters, back, saddle, loins and haunches

Mortality - loss of life on an average scale; the number of deaths in a given period; death rate

Neonatal - newly born

Nutrient - any chemical compound or group of compounds of the same chemical composition that aids in the support of animal life

Outbreeding (outcrossing) - the mating of two rabbits of the same breed but of different bloodlines or strains

Ovulation - the releasing of eggs for fertilization

Pair - a male and a female rabbit of one variety

Palpate - to feel for developing young in the uterus through the abdominal wall of the doe

Parturition - the act of bringing forth young; birth

Parasites - internal or external organisms that live in or on the host rabbit at whose expense it obtains food, shelter, etc.

Pedigree - a written chart showing the ancestors of the rabbit, date of birth, sex, breed, etc.

Postpartum - following birth

Pot belly - a distended condition of the stomach and intestines caused by improper food, usually found in young rabbits

Progeny testing - judging the worth of the parents by the performance of their offspring

Purebred - a recognized breed kept pure for generations

Random mating - mating within a selected group with no attention to a definite mating system or herd improvement

Recessive - the characteristic of one parent which when transmitted to offspring is concealed by the dominant characteristic of the other parent

Registration - the official recording of a rabbit that has been approved by a licensed registrar

Ribs - the curved portion of the sides immediately back of the shoulders above the belly

Roaster - a marketed rabbit larger and older than a fryer - usually 2.75 kg (6 lb) or more live weight

Roughage - course fibre such as hay, grass, etc.

Rump - the hind portion of the back and backbone

Saddle - the rounded intermediate portion of the back between the shoulder and loin

Selection - sorting out in various ways the types of rabbit better fitted for production, etc.

Senior - a rabbit six months of age or older

Sexing - determining the sex of a rabbit

Shoulder - the uppermost joint of the foreleg, connecting it with the body

Sire - the male parent

Slobbers - excessive salivation creating wet and unsightly fur around the mouth and lower jaw

Snuffles - a contagious infection of the nasal passage and respiratory organs

Sore hocks - an ulcerated condition of the footpads or soles of the feet

Standard - the characteristics for a breed of rabbits as written up and approved by a registering organization

Strain - rabbits in any standard breed of the same family blood having the quality of reproducing marked characteristics

Stress - pressure or strain caused by an adverse force or influence; a condition demanding a markedly strained effort

Stringy - the quality of having ropy or sinewy flesh - noticeably in the larger breeds of rabbits not properly fattened for market

Sway-back - having a distinct fall or scoop in that portion of the back between the shoulders and the hindquarters

Tattoo - to make a permanent identification mark in the ear of a rabbit through use of a perforating instrument and the application of ink

Trait - distinguishing feature in character, appearance, habit or portrayal

Typical - serving as an ideal representation of any given breed or variety as applied to type, color or fur quality

Variety - a group within a breed identified by color

Wall Eyes (Moon Eyes) - having a milky film over the cornea

Weaning - separating the young from the doe

Wry-tail - tail abnormally bent, curled or twisted permanently to one side

Wry Neck - head twisted to one side due to loss of equilibrium caused by inflammation of the inner ear.

REFERENCES

This publication, prepared for Alberta Agriculture by Briarpatch Farm Ltd., is the result of detailed research from all the existing publications available on rabbits to date, including:

1. *Commercial Rabbit Raising*, Agriculture Handbook No. 308, U.S. Department of Agriculture, 1971.
2. *Domestic Rabbits: Diseases and Parasites*, Agriculture Handbook No. 490, U.S. Department of Agriculture, 1976
3. *Economics of Rabbit Production*, Alberta Agriculture, 1982
4. *Journal of Applied Rabbit Research*, Oregon State University
5. *Manual of Rabbit Farming*, by Marjorie E. P. Netherway, 1977
6. *Official Guidebook of the American Rabbit Breeders Association Inc.*, Bloomington, Ill., 1973
7. *Rabbits*, a magazine published by Countryside Publications, Waterloo, Wisconsin
8. *Raising Rabbits the Modern Way*, by Robert Bennet, 1975
9. Oregon State University Rabbit Research Center
10. Enos, H.L., and D.D. Caveny *et al*, *Equipment Management Options to Facilitate Year-Round Rabbit Production*, Colorado State University, Fort Collins, Colorado.